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TOWARDS ADEQUACY OF SCIENTIFIC AND TECHNICAL MANPOWER

IN the present context of inadequate supply of scientific and technical manpower in our country, the recommendations* of the National Manpower Council of the U.S.A. will be read with wide interest. In the course of its report, the Council observes, "Nothing short of a determined co-operative effort involving government, industry, educational institutions and professional and other groups will attain this goal."

Such a co-operative effort, supported by informed public opinion, is to be achieved in regard to the following objectives: development of more reliable knowledge about our human resources; strengthening of the institutions which train scientists and professionals; maintenance of a continuous flow of students through colleges and universities; increased opportunities for capable young persons to secure higher education; and better utilisation of the available supply of scientific and professional personnel.

In regard to the first objective, the Council recommends that foundations and universities encourage and support research designed to increase our understanding of educational and career choice processes, of the factors facilitating the development of talent and intellectual ability, and of the conditions contributing to superior performance; that private and governmental agencies concerned with the development and utilization of scientific and professional manpower intensify their efforts to collect and analyse significant information about these critical resources; and that the Federal Government, because of its specific responsibilities and unique facilities, institute suitable guidance in the matter.

By way of strengthening the institutions which educate and train our scientists and professionals, the Council recommends: (1) that state and local governments, alumni, business, labour, and other interested groups and individuals intensify efforts to provide the financial

* *A Policy for Scientific and Professional Manpower.* Prepared by the Research Staff of the National Manpower Council, New York. Columbia University Press, 1953.

support required for the improvement of faculties and facilities; (2) that the President appoint a Commission composed of Government, university and industrial representatives to review the impact of governmental research and development contracts upon the primary responsibilities of universities and colleges to advance fundamental knowledge and train the scholars and scientists of the future; and (3) that institutions of higher education recognise that a dynamic society requires the kind of education and training that equips students to meet not only the demands of their first jobs but also the challenges of new tasks and problems which they will face years later.

To help maintain a continuous flow of students in colleges and universities, it is recommended that the public continue to support the present student deferment programme and that the sufficient flexibility be exercised in the matter of calling to active duty of students enrolled in ROTC programmes so that well qualified students are permitted to pursue graduate work prior to their military service.

In regard to the provision of greater opportunities for young people for higher education, the Council requires that the public and elected officials fulfil their responsibility to maintain good elementary and secondary schools by providing the financial and personnel resources needed to remedy present weaknesses in the educational system; that schools, professional societies, governmental agencies, and other interested groups act together to strengthen high school and college information and counselling services to insure sound organisation of schools, courses and careers; and that scholarship and fellowship programmes supported by private and public funds be maintained and expanded to help more young people of ability to acquire a higher education.

Towards the last objective, *viz.*, better utilisation of available scientific and professional personnel, the recommendations of the Council are: (1) that the President initiate a review of legislation and administrative procedures governing the recall of reservists to active duty in order to develop a system of providing civilian participation in determining the distribution of scientific and professional personnel required to meet civilian and military needs; (2) that management intensify its efforts to determine the most effective balance among the different types of manpower it employs in order to insure efficient and economical operations and to provide for the further training of the manpower for which it is responsible; and (3) that business and Government intensify their efforts to develop executives who understand the importance of insuring that each highly trained employee has the opportunity to utilize his capacities as fully as possible.

Considering that the provision of right channels of training in science and technology go a long way in solving the problem of adequate national manpower, reference may also be made here to the valuable suggestions of Sir Richard Southwell on the subject, in the course of his Trueman Wood Lecture this year.†

Sir Richard holds that in every country the structure of technological education is (and should be) conditioned by the structure of its industry, and that this in turn is conditioned by its history and will not be understood except through study of it. Naturally, in planning the educational structure of a country, one must have regard to the structure of *its* industries. Proposals which would merely copy other nations without enquiry as to why their practice is different, defeat themselves. As he says, "If it is better designed to meet like needs, then let us copy it by all means; but let us be certain, first, that the needs it meets are not also different."

In regard to the role which the universities can play in a national plan for training in technology, Sir Richard's views are very interesting. The universities are to be, in his opinion, the GHQ of the 'science which is pursued with a view to application', but *not*, be it noted, as having direct concern with applications. The teaching at undergraduate level should aim to instil a knowledge only of basic principles, and develop the power to grasp the essentials of a problem. Like medical schools they are to train men not to practise but to learn; to learn an art which calls for more than technical erudition.

The universities will also train at the post-graduate level: not only (as in the past) by supervised research of the kind that results in theses, but also (what a few have started already) by courses in the harder and newer parts of applicable science. To this end their teachers will keep close contact with the monotechnics and, through them, with industry; both as advisers and by visits in which they will learn of new industrial problems. Being the GHQ, the 'headquarters troops' must be mobile enough, if the larger ends of scientific and technical manpower are to be served adequately.

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† *Training for Science and Technology.* The Trueman Wood Lecture by Sir Richard Southwell, F.R.S. *Jour. Roy. Soc. Arts*, **1953, 51**, 794.

NOBEL AWARD FOR PHYSICS, 1953

THE NOBEL PRIZE FOR PHYSICS this year has been awarded to Professor Fritz Zernike of Groningen University, Holland, for his invention of the phase contrast microscope. Professor Zernike is now aged 65. He took his Doctorate Degree at the University of Groningen in 1915 and has continued to work in the same institution ever since.

Professor Zernike has made significant contributions to wave optics and diffraction theory, both in the field of optics and x-rays. The celebrated Zernike-Prins formula for the diffraction of x-rays opened a new line of investigation for understanding the structure of liquids. Ideas of phase contrast were put forward and discussed by Zernike in several papers even in the 1930's, but it was mainly in the post-war period that it has been widely applied in microscopy.

It is true to say that progress in a vast field of biology has been held up owing to the lack of a satisfactory method of observing the structure of living cells. In ordinary methods of microscopy, these could be studied only by fixing and staining the required structures. This is so, because a living cell is a highly transparent object and no differentiation between the different structures would be observable unless they are preferentially stained. Nevertheless the cell is composed of regions of different refractive indices, so that they offer varying optical paths to a beam of light going through it, and thus produce varying phase changes in the different regions of the transmitted beam. In the phase contrast microscope, these changes in phase are converted into variations of intensity, by introducing an optical device known as a "phase plate", into an ordinary microscope. The thicker regions would appear darker, thus producing the necessary contrast in the appearance of the cell. Indeed, we might regard the effect of phase contrast illumination as similar to a (hypothetical) dye which is stained at every point of the object with an intensity proportional to its thickness.

The phase contrast microscope has proved to be invaluable in the study of living cells in their natural state. The biologist who studies such materials can now be reasonably confident that the image he sees gives something approaching a true picture of what is actually present. The importance of phase contrast microscopy to biological research cannot therefore be overestimated.

NOBEL AWARD FOR CHEMISTRY, 1953

THE NOBEL PRIZE FOR CHEMISTRY has been awarded this year to Professor Hermann Staudinger of Freiburg University, West Germany, for his classical investigations in high polymer chemistry extending over three decades.

Professor Staudinger started his researches about 1915 with naturally occurring complex organic substances like cellulose, rubber, etc., whose behaviour was puzzling to the early orthodox organic chemists, who consequently discarded these substances from their range of investigations. Staudinger has held the view right from the beginning that structural theories of organic chemistry are quite adequate to deal with these complex organic molecules. In fact, he brought order into the so-called 'anomalies' of complex organic molecules, to which he gave the name 'macro-molecules', and therefore he can be aptly described as the father of modern high polymer chemistry. His researches have however found the greatest appreciation only in the past few years, because of the tremendous value they have lent to the industrial high polymers, *viz.*, plastics.

Professor Staudinger's researches were concerned with cellulose, rubber, fibroin, polyoxymethylenes and ethylenes, polyindenes and polyvinyl compounds, notably polystyrene and polyacrylic esters. These investigations, quite apart from their utilitarian aspect to plastics industry, have given a great insight into various fundamental aspects of the phenomenon of polymerization itself. In fact, models of these synthetic polymers are highly useful in explaining the structure and properties of natural polymers. The Staudinger relation between the viscosity and molecular weight of a macromolecule in its various modified forms has been an invaluable tool in the hands of high polymer chemists all the world over. Staudinger has also tried to explain the physical properties of high polymers such as their elastic, rubbery, viscous, resinous and thermohardening behaviours, as well as their technical properties like toughness and tensile strength on the basis of the nature, configuration and interaction of the units in the long chain macromolecule.

Professor Staudinger has had a wide influence in building new schools of research in high

polymer chemistry, initially in Switzerland and later in Germany. He was for sometime Head of the Department at the Karlsruhe Chemical Institute, and afterwards at the Technical High School, Zurich. Later he was appointed to the Chair of Organic Chemistry in the University of Freiburg.

Professor Staudinger has also evinced great interest in the practical applications of his investigations and therefore has come to play no small role in the development of the plastics industry in Germany.

M. SANTAPPA.

ARCHITECTURE OF TECHNOLOGY AT THE MELLON INSTITUTE, U.S.A.

JUST as applied science relies on pure science, so does technology depend upon applied science, as is shown comprehensively in the current investigational programme of the Mellon Institute contained in their annual report, No. 40, for 1952-53.

Forty-five years have passed since the Institute's Non-Profit Fellowship System originated by Robert Kennedy Duncan (1868-1914) was put into operation in alliance with University education and research. The fellowship system has clearly demonstrated that societally valuable results and professionally important gains could be expected from thoroughly directed long-range scientific research. The Mellon Institute was founded at Pittsburg, Pennsylvania in 1913, by Andrew W. Mellon (1855-1937) and Richard B. Mellon (1858-1933). The accomplishments of the fellowships since their foundation have had the cumulative effect of bringing many more proposals and much more support for research, and of inducing the provision of special scientific services to the whole research staff. The Institute has proved that it can generate achievements welcomed as useful to humanity. Its administrative principles have cut down the lag between scientific discovery and its practical application. Since 1907, there have been a total of 438 fellowships of which 363 have concluded their researches. The average tenure of these fellowships was 4¼ years. The remaining 75 fellowships now at work, have an average of 12 1/3 years.

Among the sciences predominating in the Institute's activities, chemistry, physics and biology are joined securely by many connecting links. It is recognised that there can be no boundaries between the sciences in the search for needed knowledge and a number of these sciences can well have joint efforts of advantage in wide investigational programmes. Multiple fellowships of the Institute often have specialists in several sciences.

The Institute has never been so pre-occupied with applied science that it has not devoted much attention to pure science. It maintains a well delineated continuing series of basic researches, which have demonstrated the advantageous broadening and strengthening of the Institute's functions in pursuing a many-sided attack on major problems of science and technology.

Scientific enquiry of chiefly or entirely a theoretical nature often results as a bypath of applied research. This architecture of technology has yielded 2,429 contributions to the literature of science since 1910. In the fiscal year 1952-53 the Institute's expenditures for pure and applied researches amounted to 2 crores of rupees. Of this sum, 40 lakhs were spent in supporting creative investigations in pure science. 116 members of this Institute have been engaged in pure science research, while 279 fellows and 221 aids have been working on the industrial fellowships. The Institute has also a loyal and capable servicing staff of 216.

The constitution of the Institute's departments and fellowships is clearly defined and the careful selection of the members assures good syntality (group personality) as well as requisite scholarship and resourcefulness. There are many incentives for continuous all-out investigational effort.

A prominent feature of the Institute is that its fellowships, while they keep within their defined purposes, do not work in isolation. The spirit and habit of collaboration stressed in the Institute add constantly and considerably to the vigour, harmony and unity of its work. This cherished team-work conduces to close professional and social association, and promotes cohesiveness.

M. A. GOVINDA RAU.

IN VITRO SYNTHESIS OF CITROVORUM FACTOR ACTIVITY BY RAT BLOOD

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THE recognition of a new factor in liver[1] and in fermentation liquors[2] which supports the growth of *Leuconostoc citrovorum* 8081 and its close relation to pteroyl glutamic acid (PGA)[3,4] has been followed by its synthesis (folinic acid,[5] leucovorin[6]) from PGA and isolation from liver in a crystalline form.[7] Excretion of this factor (CF) in urine is in proportion to the amount of PGA in the diet.[8] CF concentrates and leucovorin are more effective than PGA in reversing antagonists of PGA for micro-organisms and mice;[4] natural CF in this respect is nearly twice as active as the synthetic product.[7] Leucovorin is also much more active than PGA in inducing the disappearance of megaloblasts in cultures of bone marrow of untreated patients with pernicious anemia.[9] These findings along with observations on the enzyme systems present in rat liver[10] and in *Lactobacilli*[11] converting PGA to CF would indicate that CF or a derived product from it is the functional form of PGA.

The ability of blood cells to convert riboflavin to flavinadenine dinucleotide,[12] nicotinic acid to nicotinamide mononucleotide[13] and thiamine to co-carboxylase[14] suggested this search for the presence of a similar mechanism in blood for the conversion of PGA to CF activity.

Adult albino rats (inbred Wister strain) were maintained on the laboratory stock diet or in the case of folic acid-deficient rats, on the purified folic acid-free ration of Fatterpaker *et al.*,[15] with supplementation of 0·15 mg. per kg. of vitamin B_{12} (Merck) and 2 per cent. phthalylsulphathiazole. The blood, withdrawn under phenobarbitone anesthesia from the portal vein was collected into chilled, citrated Erlenmeyer flasks and quickly utilized for the experiments.

The procedure followed for the *in vitro* synthesis of CF consisted in incubating at 37° C. a mixture of 2 c.c. blood and 2 c.c. Krebs-Ringers phosphate buffer of pH 7·4, together with appropriate additions (Table I) and water to a total volume of 5 c.c. At the end of 3 hours, the contents in each vessel, after adjustment to neutral pH, were autoclaved for 15 minutes at 15 lb. pressure, cooled, homogenised and centrifuged. The supernatants which were often turbid were assayed titrimetrically[16] for CF activity using *L. citrovorum* 8081 as the test organism and leucovorin (Lederle) as the standard. The cells in duplicate sets of flasks were crushed well after incubation and pH brought to 7·6. The contents were next autolysed under toluene for 24 hours at 37° C. prior to assay after neutralization and autoclaving as above. Under these conditions there was maximum release of bound CF which accounted for most of the CF activity. Enzymic release of bound CF[23] was not resorted to on account of the high blanks.

From the results presented in Table I, it may be observed that the blood system could convert PGA to CF. This synthetic ability is destroyed if the blood were heated at 100° C. for 3 minutes. The values with the autolysed samples suggested that the enzymes for this conversion resided in the cells and was confirmed in other experiments with the formed

TABLE I

Synthesis of CF activity from PGA by normal and PGA-deficient rat blood

Supplements	Normal animals		PGA-deficient animals
	Before autolysis	After autolysis	After autolysis
	CF mμg. per c.c. blood		
Blood	0·20	4·92	<0·2
Blood + PGA (10 μg.)	1·72	8·90	9·0
Blood + PGA (10 μg.) + AA* (10 mg.)	3·20	13·72	13·0

* Freshly neutralised ascorbic acid (AA)

elements of the blood only. The effect of ascorbic acid in enhancing CF synthesis is appreciable as with liver slices.[10]

Maximum synthesis with intact cells occurred in 3 hours of incubation and, under comparable conditions crushed cells did not show much synthetic ability for CF. These observations excluded the possibility of any synthesis occurring during autolysis, the increased values for CF being therefore, attributable to liberation from bound forms only.

The results with blood from PGA-deficient animals, included in Table I, would show that though there is negligible CF activity present initially, incubation with PGA with or without AA produces nearly as much CF as with normal blood. However, there is evidence to suggest that in a folic acid deficiency induced by aminopterin there is almost complete impairment of this enzyme system.

Aminopterin addition to the incubating mixture (Table II) blocks the conversion of PGA to CF by the blood cells considerably (*cf.* 17); for these experiments, the standard curves were run in presence of aminopterin and it was ascertained that, in the dilutions employed, it made no difference from normal in the response to growth by the organism. Since aminopterin is also known to interfere with the utilization of CF in micro-organisms,[3,18] it would seem that this antagonist may have two or more important sites of action and interference with the metabolic alteration of PGA is only one of them.

TABLE II

Effect of aminopterin on in vitro *synthesis of CF from PGA by normal rat blood*

Supplements	CF mμg. per c.c. blood
Blood	5·0
Blood + FA (10 μg.)	9·4
Blood + FA (10 μg.) + Aminopterin (5 μg.)	4·8
Blood + FA (10 μg.) + AA (10 mg.)	14·2
Blood + FA (10 μg.) + AA (10 mg.) + aminopterin (5 μg.)	6·2

In an attempt to characterize the CF activity synthesized by the blood cells, a dose response curve was obtained for *L. citrovorum* against increasing concentrations of the blood filtrate and was found to differ from a similar curve with equivalent concentrations of Leucovorin (Fig. 1). Such a difference was also seen with the xanthine culture filtrate of *L. arabinosus* which synthesizes considerable CF activity from *p*-aminobenzoic acid[19] and has recently been

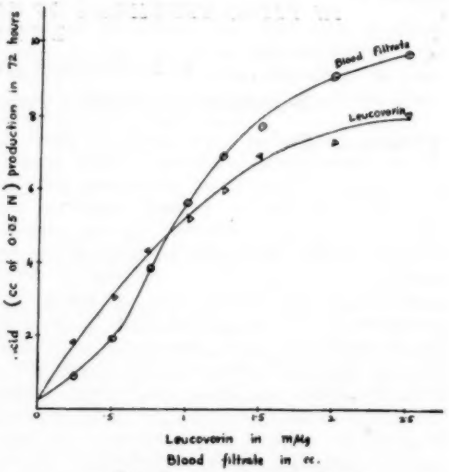

FIG. 1. Dose Response Curve

reported for Hemofolin,[20] a factor synthesized when leucocytes from bone narrow are incubated with PGA. While there are reports of probable new factors[21,22] and conjugates[23] related to CF, it is possible that presence of inhibitors or activators in blood filtrates and other crude extracts may account for the observed differential response. Bioautographic studies to characterize the CF activity are in progress.

Our thanks are due to the Indian Council of Medical Research for supporting this work and to Lederle Laboratories, Ltd. and Chas. Pfizer, Inc., for generous supplies of chemicals.

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NATIONAL RESEARCH COUNCIL OF CANADA—POST-DOCTORATE FELLOWSHIPS

THE NATIONAL RESEARCH COUNCIL OF CANADA will award for 1954-55 approximately 40 Post-Doctorate Fellowships for research in chemistry and physics, tenable in the National Research Council Laboratories at Ottawa, and 10 Post-Doctorate Fellowships in the biological sciences, tenable in the Prairie Regional Laboratory of the National Research Council at the University of Saskatchewan, Saskatoon, and in the laboratories at Ottawa.

Chemistry: (approximately 25 awards, tenable in the Ottawa Laboratories).—Chemical Kinetics and Photochemistry; Surface Chemistry and Low Temperature Colorimetry; Molecular Spectra; Organic Chemistry with Special Reference to Alkaloids and Other Natural Products; Mechanism of Organic Reactions; Absorption Spectra of Organic Compounds; Physical Properties of Liquids and Gases; Critical Temperature Phenomena and Liquid Structure; Catalysis; Colloids; Corrosion Research; Chemical Engineering; Metallurgical Chemistry; Polymer Chemistry.

Physics: (approximately 15 awards, tenable in the Ottawa Laboratories).—Molecular Spectra; Molecular Beams; Cosmic Rays; X-Ray Diffraction; Low Temperature and Solid State Physics; Theoretical Physics; Acoustics; Photographic Optics; Photogrammetric Research; Atmospheric Optics; Radiology.

Biological Sciences: (approximately 10 awards, tenable in the Saskatoon and Ottawa Laboratories).—Microbiology; Fermentation Chemistry and Enzymology; Carbohydrate Chemistry; Biosynthesis of Lignin; Chemistry of Vegetable Oils and Fats; Enzymatic Studies of Proteins; Photosynthesis; Biometrics; Animal Biochemistry.

An applicant should not be more than 35 years of age and should possess a Ph.D. Degree from a recognised University or expect to obtain such a Degree before taking up this award. There are no restrictions as to the nationality of the applicant, but successful applicants must meet all Canadian immigration requirements. For single Fellows the stipend is $3,000 per annum, and for male Fellows who are married, the stipend is $3,500 per annum. This award is tax-free and payments are made twice monthly. A grant-in-aid of travelling expenses will be made to persons coming from abroad. A further grant will be paid to a married Fellow if his wife accompanies him to Canada. A similar grant will be made on the termination of the Fellowship if the holder is returning to his home abroad. Fellowships are tenable for a period of one year, but applications for a renewal for a second year will be considered.

Applications shall be made on a special form that may be secured from the Secretary, Laboratories Awards Committee, National Research Council, Ottawa, Canada, or from the Chief Scientific Liaison Officer, National Research Council of Canada, Africa House, Kingsway, London, W.C.2, England, and should be submitted direct to the Ottawa address, not later than February 15, 1954. For additional information regarding these Fellowships, attention is directed to a booklet entitled "National Research Council Post-Doctorate Fellowships".

INSTITUTE OF PHYSICS (INDIAN SECTION), LONDON

As the result of a recent postal ballot, the Committee of the Indian Section of the Institute of Physics, London, has been reconstituted as follows: Sir C. V. Raman (*Chairman*), Dr. S. S. Bhatnagar, Dr. K. S. Krishnan, Prof. G. I. Finch, Dr. S. Ramachandra Rao and Mr. T. N. Seshadri (*Hon. Secretary*).

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A PARADOX RELATED TO POISSON'S EQUATION

Let us consider the whole space filled with matter of uniform density, $\rho(\rho \neq 0)$ say. Then from symmetry there is no gravitational field of force because the attraction of any element is counteracted by that of another element situated at the opposite direction but at equal distance. Therefore we get the gravitational potential $\phi = \text{const.}$

Now by Poisson's equation

$$\nabla^2\phi = 4\pi\rho$$

If we put $\phi = \text{const.}$ in the equation,

we get $4\pi\rho = 0$

which contradicts the hypothesis $\rho \neq 0$.

The explanation of this paradox is to be looked for in the meaning of the statement: 'whole space filled with matter'. This may be looked upon as a body of large dimension (*e.g.*, a sphere of radius R) and of uniform density (ρ) and then considering that the dimension increases without limit ($R \to \infty$). Looked at this way, the argument using symmetry stated above will fail because any point of a large sphere (except the centre) is not symmetrically situated with respect to the sphere and forces on all sides will not balance one another.

This solution of the paradox however does not appear to us satisfactory. The whole difficulty is over the meaning of the phrase 'the whole space filled with matter of uniform density ρ', the meaning of which to us is $\rho\ (x, y, z) = \text{const.}$ (for all values of x, y, z) and not as follows: At first defining

$$\rho\ (x, y, z) = \text{const. when } x^2 + y^2 + z^2 < R^2$$
$$\text{and} = 0 \qquad \text{when } x^2 + y^2 + z^2 > R^2$$

and then making $R \to \infty$.

No satisfactory solution has appeared to us.

I wish to thank Sri. P. K. Ghosh of the University of Calcutta with whom I had a detailed discussion of the problem and who indeed suggested the solution ($R \to -\infty$, etc.).

Indian Inst. of Tech., G. BANDYOPADHYAY.
Kharagpur, *January* 16, 1953.

COMMENTS ON THE ABOVE PARADOX

WE are dealing here with two fields, one a scalar density field $\rho(x, y, z) = c$ (for all x, y, z), and the other the gravitational (vector) field connected with the distribution. Since the whole of infinite space is involved, we have to deal with infinite triple integrals and questions of convergence and uniqueness arise. It is found that there is no *unique* force field connected with the postulated mass distribution, and so no question of potential or Poisson's equation arises.

Let P and C be two points distant d apart. Consider the mass distribution for which $\rho = c$ for points inside a sphere centre C and radius R, and $\rho = 0$ outside. The force at P is along PC and increases till R increases to d after which it remains constant ($= \gamma 4\pi dc/3$, γ being the constant of gravitation) since a uniform spherical shell exerts no attraction at an interior point. Hence when $R \to \infty$ so that the density is c everywhere, the limit of the field vector at P is $\gamma 4\pi dc/3$ towards C. Thus, by taking different positions of C (while keeping P fixed) and making $R \to \infty$, we get different fields all related to the given density distribution. Hence, *there is no unique force field associated with the given mass distribution* and no question of potential or Poisson's equation arises.

To put the same thing in a different way, consider any uniform finite mass distribution of which P is an interior point. We can pair off any matter around a point Q_1 with corresponding matter round Q_2, where Q_1 and Q_2 are symmetrically situated about P. Their attractions at P cancel out. But after this has been done, there may remain residual matter on one side. Mr. Bandyopadhyay assumes that if this unbalanced matter is sufficiently far off, say, the nearest point being at a distance R from P, then its attraction at P tends to zero when $R \to \infty$. In other words, it is assumed that an infinite distribution of ultimately zero density has a zero field. Since we may add a zero mass distribution without affecting any existing distribution, the above assumption is implicit in postulating the existence of a unique associated force field. The above assumption, however, is incorrect as the following example will show:

Let APB be in a straight line with $AP = PB = d$, and let r_A and r_B denote the distance of any point Q from A and B. Consider the region of points Q defined by $r_A > R$, $r_B < R$, $(R > 2d)$, bounded by 2 spherical caps. The nearest point of this region from P is $R - d$ and the attraction at P of matter of density c filling this region is seen to be $\gamma 4\pi dc/3$ towards B, and is independent of R. Making $R \to \infty$ we see that matter with density which is ultimately zero everywhere (*i.e.*, entirely at infinity) is exerting a finite force at P.

In some paradoxes the mistake is in the argument, but in others like the one under discussion, it is there right at the very start, in assuming the existence of a unique force field associated with the given distribution. This ambiguity will arise for every mass distribution covering the whole of space, under the inverse square law of attraction.

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VARIATION OF VISCOSITY OF LIQUIDS WITH TEMPERATURE

ANDRADE[1] has suggested the formula

$$\eta_T v^{1/3} = Ae^{c/vT} \qquad (1)$$

for the variation of viscosity of a liquid with temperature, where the symbols have their usual meanings.

A modified form of Sutherland's[2] formula for gases is suggested here to account for the variation of viscosity of liquids with temperature, which is found to be more accurate than (1). Sutherland's theoretical formula is

$$\frac{\eta_T}{\eta_{273}} = \left(\frac{T}{273}\right)^{3/2} \frac{K+273}{K+T}. \qquad (2)$$

K is a constant for a particular gas and is positive. But for liquids it comes out to be negative, because their viscosity decreases with increasing temperature. Also, K is not a constant. It slowly decreases with the rise of temperature and may be denoted by $K = f(T)$.

Empirically this function has been found to be $K = S(\log_{10} T)^n$, where S and n are characteristic constants for a particular liquid. Equation (2) accordingly becomes

$$\frac{\eta_T}{\eta_{273}} = \left(\frac{T}{273}\right)^{3/2} \frac{S(\log_{10} T)^n + 273}{S(\log_{10} T)^n + T}. \qquad (3)$$

Table I gives the value of n for different liquids. The validity of the formula is shown by the constancy of S in the case of different types of liquids like water, alcohols, glycerine

and mercury. Table II shows the variation of S with T for two liquids. The detailed results are similar for the others.

TABLE I

Liquid	..	n
Water	..	1·0
Methyl alcohol	..	1·0
Ethyl alcohol	..	2·302
Glycerine	..	1·0
Mercury	..	1·584

TABLE II

T° K	Water		Mercury	
	η^*	$-S$	η^*	$-S$
253	..	..	·0186	41·64
273	·01793	..	·0169	..
283	·01311	102·3	·0162	42·51
293	·01006	102·6	·0156	41·67
303	·00800	102·6	..	..
313	·00657	102·1	..	..
323	·00550	102·7	·0141	42·17
333	·00469	102·5	..	..
343	·00406	102·8	..	..
353	·00356	102·3	..	..
363	·00316	101·8	..	..
373	·00284	101·9	·0122	42·64
473	..	..	·0101	42·51

* In C.G.S. units.

The experimental values of viscosities of different liquids have been taken from Kaye and Laby's 'Physical and Chemical Constants'.

The author's grateful thanks are due to Dr. K. Majumdar for his interest and valuable advice and to Mr. M. S. Sodha and Mr. Y. P. Varshni for their helpful suggestions.

Dept. of Physics, SHASHANKA SHEKHAR MITRA.
University of Allahabad,
Allahabad, *August* 7, 1953.

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PITCHSTONE FLOW IN RAJMAHAL HILLS, BIHAR*

WHILE mapping the different flows of basalts in Rajmahal Hills, Santal Parganas, Bihar, during 1952-53, the author noticed a flow of pitchstone occurring near Berhait (24° 53'; 87° 36'; Survey of India Topo Sheet No. 72 P/9) and Taljhari (25° 05'; 87° 45'; Sheet 72 0/12). This note is communicated since this is the first recorded occurrence of pitchstone flow in India and its association with basalts is also of considerable petrological interest.

The flow is exposed over a distance of two miles in a nala, two miles SSE of Berhait. Two more exposures are found near Berhait and in the section of the Gumani River, two miles NNE. The area in between the exposures is covered by soil. Near Taljhari, about twenty miles NNE of Berhait, the flow is exposed over a distance of three miles all along the base of the hills. The exposed thickness of the flow in the Railway Quarry is 30 ft.

The pitchstone is glassy, with a pitchy lustre and breaks with a conchoidal fracture. The rock weathers into a greenish grey mass. The upper surface of the flow is highly amygdaloidal and it is seen in the Railway Quarry near Taljhari that the amygdules are restricted to the top (5 ft.) portion of the flow and become scarce at lower levels. Locally the vesicles are elongated in the direction of the flow. In places near Berhait, the rock lacks the glassy appearance and contains mega-phenocrysts of felspar.

In thin sections the pitchstone is seen to consist of a few phenocrysts of plagioclase (oligoclase), hypersthene and augite in a matrix of brownish glass containing numerous microlites of sodic plagioclase (albite and oligoclase), pyroxenes and magnetite. Perlitic cracks and spherulites are also noticed. The rock is feebly magnetic.

The specific gravity of these rocks varies from 2·400 to 2·538 while that of the basalt is above 2·900. The maximum refractive index of the glass is 1·520. The percentage composition of the glass, as computed from the refractive index[1] would be as follows:

SiO_2, 64; CaO, 3·9; MgO, 1·6; K_2O, 3·6; and Iron, 6·0.

Further detailed studies are now in progress.

Geological Survey of India, C. S. RAJA RAO.
Calcutta-13, *July* 29, 1953.

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* Communicated with the kind permission of the Director, G. S. I.

GARNET-SILLIMANITE-CORDIERITE RELATIONSHIP IN KHONDALITES

THOUGH Cordierites have been reported from several localities in the garnet-bearing *para*-gneisses of South India, very little has been said about the relationship between garnets and cordierites in these rocks.

During a regular geological survey of the Khondalites and associated rocks in the Bobbili-Salur area of Srikakulam District by the author, an interesting suite of cordierite-bearing rocks such as garnet-sillimanite-cordierite gneiss and cordierite-sillimanite gneiss were distinguished

in the field. A detailed optical examination of micro-sections of these types has yielded some very interesting data which throw light on the genetic relationship of cordierites to the garnets and sillimanite.

In the garnet-sillimanite-cordierite gneiss, sillimanite occurs as fibrolitic inclusions in the garnets. It is seen to occupy, in stages, almost the whole of the garnet. Cordierite occurs in minor quantities, interstitially between crystals of garnets, in these rocks. In the next group of rocks, *viz.*, cordierite-sillimanite gneisses, garnet as such is almost entirely absent but palimpsests of this mineral are definitely recognised. The progressive alteration or change of garnetiferous rocks into garnet-sillimanite-cordierite and cordierite-sillimanite rocks are successively traced in the micro-sections.

The relict garnet and cordierite appear to have genetic relationship as is evidenced by the following observations: (*a*) the occurrence of the two minerals in association; (*b*) the increase of cordierite with corresponding decrease of garnet in the stage represented by cordierite-sillimanite gneiss; (*c*) the development of cordierite in the interstitial spaces of garnet, at times exhibiting a vermicular structure; and (*d*) the elongated porphyroblasts of cordierite apparently pseudomorphous after garnet with numerous inclusions of sillimanite, lying in the trend of the original garnet-bands.

FIG. 1

Garnet-Sillimanite-Cordierite Gneiss

C—Cordierite, G—Garnet, Si—Sillimanite, P—Pleochroic Haloes, F—Felspar.

It is suggested that the sillimanite is formed from the alumina and silica released by the breaking up of the garnet. This process takes place till the residue of the garnet molecule affords adequate material for the formation of cordierite. It is suggested that the end products of the breaking up of garnet are essentially cordierite and sillimanite (Fig. 1).

A detailed paper embodying the results of chemical analyses and optical studies will be published elsewhere.

My thanks are due to Prof. C. Mahadevan for the keen interest he has evinced in the work and for his helpful criticism.

Dept. of Geology, K. V. RAGHAVA RAO.
Andhra University,
Waltair, *August* 26, 1953.

FREEZING POINT OF CAPILLARY CONDENSED WATER

A CONSIDERABLE amount of experimental work on the freezing point of capillary condensates has been reported in literature in recent times.[1-6]

We have devised a simple dilatometric method, capable of yielding reproducible results, for determining the freezing point of capillary condensed water. By means of this technique, we have measured the freezing points of water held at different vapour pressures, in four different porous adsorbents (silica gel, alumino-silicate gel, a sample of bentonite and a sample of clay), varying largely in their pore size—distribution relationships. The results show that freezing point depression of water depends upon the radius of the capillary pores in which it is condensed, and that it is independent of the nature of the adsorbent or the amount of the moisture contained in it.

The freezing point depressions of water (average values for the four adsorbents) condensed in pores of radii less than 413, 69·4, 37·3, 24·5, 17·8, 13·9, 11·5 and 9·7 Å were found to be 0·50°, 5·63°, 10·96°, 16·0°, 22·1°, 28·2°, 32·7° and 43·8° C., respectively. These values were seen to agree well with the theoretical values calculated from thermodynamic considerations based on the theory of capillary condensation.

A detailed account of the work will be published elsewhere.

Dept. of Chemistry, BALWANT RAI PURI.
Panjab University, LEKH RAJ SHARMA.
Hoshiarpur, M. L. LAKHANPAL.
July 1953.

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OCCURRENCE OF *CLYPEINA* (DASYCLADACEAE) IN THE NINIYUR GROUP (DANIAN) OF THE SOUTH INDIAN CRETACEOUS

AMONG the abundant Dasycladaceæ recently reported[1] from the flints and cherts of the Niniyur group, and now under detailed study, we have noticed the occurrence of *Clypeina*. This interesting form is very well seen in some of the slides, revealing both longitudinal and transverse sections.

Fig. 1 is a longitudinal tangential section (the form as preserved is incomplete) and shows very nicely all the striking features of the genus. The thallus is cylindrical, though slightly tapering, and as many as 6 whorls (verticils) of branches are visible. The distance between two adjacent whorls is about 0·2-0·3 mm. Each whorl is composed of about 18-20 branches (which served as sporangial chambers) which are all upwardly directed and spread out, so as to give the whorl a beautiful cup-shaped form. The branches also show a distinct tendency to diverge gradually away from the axis at their upper margin, thus imparting a very characteristic shape to the entire whorl, well seen in the photograph.

Fig. 2 shows the transverse sections of this form, and the sporangial chambers are well seen along the outer margin away from the axial cavity. The entire diameter is about 0·9 mm. while that of the axial cavity alone is about 0·5 mm. The diameter of the sporangial cavities is about 0·08 mm.

Fig. 3 shows an oblique longitudinal section of another *Clypeina* obviously specifically different from the form in Fig. 1. Only 2 whorls are seen here (as preserved), with an intervening distance of about 0·35 mm. The number of branches in each whorl is only about 12; the shape, size and 'infundibular' form of the verticil are quite distinctive.

Fig. 4 is a transverse section and shows 12 distinct sporangial cavities along the outer margin, each with a diameter of about 0·08 mm.; but in this case, the outline of the form, as seen in transverse section, is elliptical, and not circular,—the longer diameter measuring about 0·60 mm. The axial cavity is also accordingly spindle-shaped and measures about 0·30 × 0·08 mm. This elliptical shape does not appear to be an effect of distortion during fossilization; it seems to represent the true form of the alga. If so, this would be a very interesting and unusual feature. What we see in Fig. 4 is probably a transverse section of the form shown in Fig. 3.

FIG. 1. (× 40)

FIG. 3. (× 50).

FIG. 2. (× 40)

FIG. 4. (× 50)

Only about 5 or 6 species of *Clypeina* have been described from outside India so far, and it is interesting to note that practically all of them (except one from the Jurassic) come from beds of Eocene age. So far as India is concerned, the occurrence of this genus was recorded for the first time by C. P. Varma[2] from the Danian Niniyur rocks identical with the beds from which the present forms are being described. He has considered his form as a new species of *Clypeina* and named it *C. sahnii*.

In addition to the two types briefly described above, our material seems to contain many other kinds of Clypeinas and when all these are fully studied, they will undoubtedly add considerably to our knowledge of this interesting alga about which we know so little. It may also be possible then to discuss more fully and conclusively the systematic position of *Clypeina* in the Dasycladaceæ, about which there has been some difference of opinion.

This work is under progress, and a detailed paper will soon be published elsewhere.

Bangalore, L. Rama Rao.
September 21, 1953. S. Sambe Gowda.

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VARIATIONS OF SEA LEVEL IN THE BAY OF BENGAL

Hourly tide heights in Visakhapatnam Harbour for 1950 have been averaged by days so as to give a detailed annual cycle of sea-level. It was found that the water-level undergoes an exceptionally large annual variation with one high period in June, but the maximum high level is in October and November. The lowest period is in March and a secondary low in August. The total range is nearly 2'.

To account for the annual cycles of sea-level, the atmospheric pressure difference,[1,2] wind speed and direction, rainfall,[3] and density of the water[4–6] are considered. Aside from astronomical influences, it is reasonable to assume that changes in mean sea-level ($\Delta H_{S.L.}$) may be expressed by the following relation:

$$\Delta H_{S.L.} = \Delta h_p + \Delta h_w + \Delta h_r + \Delta h\rho$$

where Δh_p is the change in height of water due to atmospheric pressure difference; Δh_w change due to wind; Δh_r change due to rainfall and run-off; and Δh_ρ change due to the density or expansion of water.

The difference in atmospheric pressure between one side of the Bay of Bengal and other was converted to inches of water-level difference. This accounts for 6" of water between winter and summer. Between the March and October sea-level extremes, atmospheric pressure accounts for 10 per cent. of the sea range. The rainfall, run-off and direct wind effect could not be accurately evaluated, but are believed to be small in Visakhapatnam Harbour.

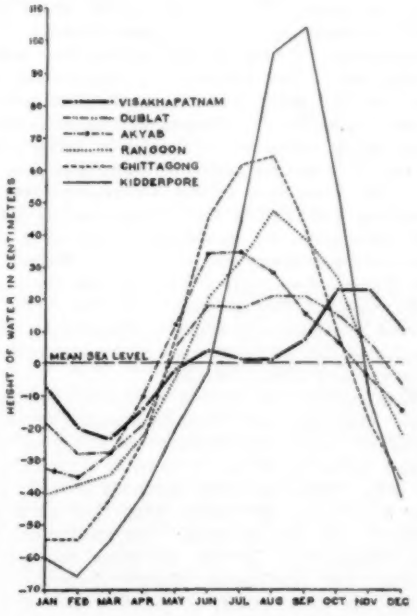

Fig. 1. Monthly average sea level over a number of years.

The major factor, however, causing the seasonal cycle of water-level has been attributed to changes in the mean vertical density of the water masses present, off the east coast of India. Vertical temperature and salinity from which the density was derived were obtained during the Andhra University oceanographic operation in 1952-53. The dynamic heights calculated from them give values of 0·710 and 1·258 dynamic meters for 0-200 meters for the months of April and October respectively, or a water-level difference of nearly 22" which can be attributed merely to the change in density of the water. This surprisingly amounts to about 90 per cent. of the total range in sea-level observed in 1950. All the range in sea-level can then be accounted for, since 10 per cent. is due to atmospheric pressure differences. However, it must be remembered that the sea-level data are for 1950, whereas the vertical density is for 1952-53.

Some density changes take place due to seasonal heating and cooling. However, most

changes are attributed to currents both horizontal and vertical which transport different water masses to and from the area. During the N-E monsoons light (low salinity, high temperature) water is transported from the north along the east coast of India. This caused high sea-level. During the spring when the S-W monsoon starts heavy (high salinity, low temperature) water exists along the coast, partly due to the equatorial water moving up the coast and partly due to upwelling[7] of deeper waters towards the surface. The secondary lowering of sea-level in August is believed to be due to a second period of upwelling.

At the same time as the August sea-level is lowering, the eastern side of the Bay of Bengal experiences its maximum height (Fig. 1). The seasonal range in sea-level is higher on the Burma coast where the greatest range in the world is found. Here, too, its cycle is caused by seasonal changes in the physical properties of the water, reinforced by atmospheric pressure and river run-off.

Short period fluctuations in water height are also observed in Visakhapatnam Harbour. Some are for a few minutes but the most frequent period is about 34 minutes with heights of 2-6". These are most common at high and low slack tide, and during neap tide when the range of the tide is lowest. The specific seiches are believed to be due to wave oscillations across the continental shelf[8,9] between the coast and deep water, or possibly due to the peculiarity of the size and shape of the harbour.

Andhra University, R. PRASADA RAO.
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NITROGEN DISTRIBUTION IN THE URINE OF RAJASTHANIS

KNOWLEDGE concerning the urinary nitrogenous excretion is an essential factor in the elucidation of the metabolic studies in human beings. Moreover, the daily excretion of nitrogen is an index of the nutritional level of the individual in regard to the proteins. The present investigation derives marked significance from the fact that the diet of the average Rajasthani is poor compared to that of an individual in other parts of India.

Earlier studies on the nitrogen partition in the urine of tropical population were carried out by Campbell,[1] McCay,[2] Ray and Ganguly,[3] and Hughes.[4] The results of a study undertaken in this laboratory on the nitrogen partition in the urine of Rajasthanis are based on the analysis of the urine of 24 normal individuals consisting of two distinct groups of persons, the one (A) comprising of male adults having sedantary occupation and hostel students receiving standard dietaries, and the other (B) consisting of mostly workmen who received low nitrogenous diet. All the subjects were vegetarians. The composition of diets fed to the two groups is given in Table I.

TABLE I
Composition of diets

	Group A	Group B
Calories ..	2,056	1,539
Total Proteins, g. ..	50·7	44·6
Total N, g. ..	8·45	7·4
Non-protein, N ..	Nil	Nil

The significance of the results as laid in Table II from the present point of view is that the value of total N and urea N (for Rajasthanis) are low compared to European and American standards and indicate a low level of protein ingestion.

TABLE II

	Rajasthani Group A	Rajasthani Group B	Europeans Cole[5]	Americans Folin[6]
Body weight in kilos	65·8	55·0	70·0	63·0
Volume of urine per diem in ml.	1407	726	1440	1430
Specific gravity	1·015	1·022	1·020	1·022
Total N in g. per diem	10·8	5·42	16·0	16·8
Urea N in g. per diem	7·9	3·42	14·0	14·7
Ammonia N in g. per diem	0·5	0·30	0·50	0·50
Uric acid N in g. per diem	0·26	0·14	0·23	0·18
Creatinine N in g. per diem	0·41	0·30	0·58	0·58
Undetermined N in g. per diem	1·5	1·3	0·70	0·85

In addition to urea N representing the main product of exogenous metabolism, ammonia derives its metabolic importance in that it is produced in amounts which are necessary for the excretion of acids from the body. Since the end products of protein metabolism are mostly acid, the ammonia output varies in the same direction as the total N output though no definite relation has been observed. The daily output of ammonia in the urine of Rajasthanis (Groups A and B) is almost the same as Europeans.

Representing the end product of purine metabolism, uric acid owes its origin partly to the purine substances of the food and partly to the metabolism of muscle proteins of tissues. Rajasthanis belonging to Groups A and B excrete 0·65 g. and 0·41 g. per diem (uric acid) respectively.

'Creatinine coefficient' defined as the creatinine N in mgm. excreted per kg. body weight per diem, by Schaffer,[7] depends upon the muscular efficiency of the individual. The general average 'creatinine coefficient' for the Rajasthani is far below the European and American standards. Full details of work and significance of results would be published elsewhere.

Biochemical Unit, K. RAMAMURTI.
Division of Pharmacy, S. N. THAMPI.
Birla College, Pilani,
Rajasthan, *May* 20, 1953.

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NON-VARIANT NATURE OF FIELD GRADIENT UNDER IRRADIATION CAUSING JOSHI EFFECT IN A.C. ELECTRIC DISCHARGE

THE marked importance of the potential distribution in the discharge space in determining the magnitude of the current i, has been emphasised by Loeb[1] and others.[2,3] It controls the number (and therefore, i) of avalanches formed by the initiating electrons produced by any of the agencies (*vide infra*). Below the breakdown potential, the field intensity (E) is linear with the distance separating the two electrodes, cathode (c) and anode (a); when the applied voltage V is large enough to cause a self-maintained discharge, it varies differently (as shown in Fig. 1), with its marked gradient in the cathode fall region. In view of the appreciable variation under light of the current i of a self-maintained discharge, giving

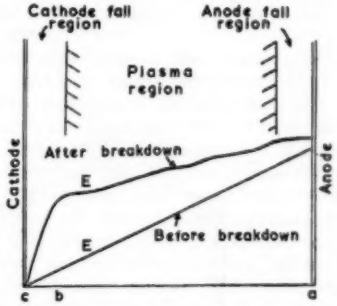


FIG. 1. Variation of Field (E) in Discharge space especially in plasma, cathode and anode fall-regions (*cf.* Ref. 3).

(positive and) negative Joshi effect, $(+) - \Delta i$[4], it was of interest to know the change, if any, of the field gradient under irradiation. The present communication points out the significance of a few results obtained during the studies of Joshi effect in iodine vapour, which indicate clearly the non-variant behaviour of the field gradient under conditions giving large Joshi effect. Iodine vapour was excited in cylindrical tubes having external sleeve electrodes to which a 50 cycle A.C. voltage is fed; and the current variations were investigated by a double beam cathode-ray oscillograph. Fig. 2 gives a typical set of oscillograms of the current in dark and under light, when the potential V was greater than the 'threshold potential' V_m of the self-maintained discharge; the studies of the r.m.s. value of i (measured by a galvanometer actuated by a diode) showed that the variation of the current due to light corresponded to 70 per cent. current suppression—negative Joshi effect. It was interesting to note that in dark, two types of pulses were observed usually (at $V > V_m$): (i) the longer pulses produced by the well-known secondary mechanisms[5] concerned with the liberation of electrons from the cathode chiefly by positive ion bombardment (γ) and photons (γ_{ph}) and (ii) shorter pulses due to other secondary processes (β) occurring in the gas phase[6] (*cf.* Fig. 2); of these last, photoionisation of the pre-excited gas particles in the cathode fall region appeared significant to (ii).[7,8] That is, an electron formed by this process acquires energy due to the field gradient and starts ionisation by inelastic collisions after travelling

a known distance away from the cathode in the field direction. The generated electron repeats the process forming electron-avalanches. The number of electrons produced in this last is fundamentally governed by the field gradient

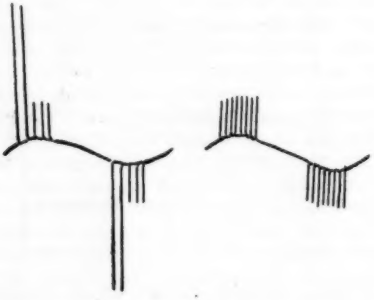


FIG. 2. Oscillograms representing the current structure in iodine vapour (0·04 mm. Hg, 28°C.) in dark and under light, at 1·9 kV (50 c/s).

and determines the pulse height. The production of shorter pulses of essentially the same height suggested that the electrons generated by photo-ionisation in the above mentioned region, travel through sensibly the same potential difference and ionise gas particles from a fixed point (*b*) away from the cathode c (*cf.* Fig. 1).[7] It has been emphasised that ionisation process between c and *b* is not excluded, but occurs by fast electrons released from the cathode by γ and $\eta\theta g$ mechanisms.[7] A significant feature of the oscillogram noticed under light was that (while the longer pulses were inhibited) more number of shorter pulses remarkably of the same height as those appeared in dark, was produced. This suggested that the aided creation under light of initiating electrons in the cathode fall region causes ionisation by impact with gas particles from the same point *b* to give the enhanced number of the shorter pulses (which is referred to as the occurrence of $+\Delta i$ simultaneously with $-\Delta i$).[9] It could occur only when the field distribution between cathode and anode, whatever manner it may be, was unaltered by additional constraint, *viz.*, irradiation, suggesting that enhanced space charges[4] altering the field gradient[1] were not formed under light.

The observation that current flowing through a system can be inhibited appreciably by light *without altering the field gradient* is of marked significance and may lead to some applications of Joshi effect, which merit investigation.

Maharaja's College, Jaipur, and
Dept. of Chemistry, Delhi University, Delhi, *January* 31, 1953.

M. G. BHATAWDEKAR.
O. P. DOGRA.
N. A. RAMAIAH.

1. Loeb, *Fundamental Processes of Electrical Discharge in Gases*, 1939, John Wiley. 2. Townsend, *Electrons in Gases, Huchinsons Sci. and Techn. Publ.*, 1947. 3. Maxfield and Benedict, *Theory of Gaseous Coduction and Electronics*, 1941, McGaaw Hill. 4. Joshi, *Curr. Sci.*, 1947, **16**, 19; *cf.* also Ramaiah, *Jour. Sci. Industr. Res.*, 1951, **10A**, 182. 5. Loeb, *Rev. Mod. Phys.*, 1936, **8**, 267. 6. Saxena and Ramaiah, *Jour. Chem. Phys.*, 1952, **20**, 1342. 7. Saxena, Bhatawdekar and Ramaiah, *Ibid.*, 1953, **21**, 365. 8. Dogra, Bhatawdekar and Ramaiah, *Proc. Phys. Soc.* (*London*), 1953, **66**, 431. 9. Jatar, *Jour. Sci. Industr. Res.*, 1950, **9**, 283.

FOSSIL WOODS RESEMBLING *MANGIFERA, SHOREA* AND *ALBIZZIA* IN THE TERTIARY ROCKS OF S. ARCOT, INDIA

THE specimens of these woods were collected by the author from Mortandra (Cuddalore sandstones?) in the South Arcot District, about 5 miles north-west of Pondicherry. From Tiruvakkarai (Cuddalore sandstones), 13 miles W-N-W of Pondicherry Professor B. Sahni[1] has described a fossil coniferous wood, *Mesembrioxylon schmidianum*. He has also described from the Cuddalore series a palm *Palmoxylon pondicherriense*.[2] The present note gives a brief account of some dicotyledonous fossil woods from this area.

Woods resembling Mangifera.—The following characters of these fossil woods indicate a very close similarity to *Mangifera*; growth rings faint, with fairly large solitary vessels. Pits on the vessels large and alternate. Fibres unseptate. Parenchyma fairly abundant and of two types, (*i*) aliform and locally confluent; (*ii*) in initial or terminal bands. Medullary rays 1-2 seriate, short and typically homogeneous.

Woods resembling Shorea.—These specimens show strong resemblances with *Shorea* in the following characters: vertical gum ducts embedded in parenchyma and disposed tangentially in long conspicuous bands. Vessels abundantly tylosed and evenly distributed. Scanty-vasicentric tracheids common. Fibres unseptate but thick-walled with numerous simple to bordered pits. Parenchyma of two types, (*i*) paratracheal, and (*ii*) apotracheal,

the former represented by scanty-vasicentric cells, and the latter consisting of short or long tangential strips. Medullary rays broad and always heterogeneous.

Woods resembling Albizzia.—The following characters suggest a close affinity with *Albizzia*; vessels mostly solitary, often with a tendency towards oblique arrangement in transverse section. Pits on the vessels alternate, often with coalescent apertures. Fibres typically septate with simple pits. Parenchyma very abundant, predominantly vasicentric to aliform, locally confluent, vaguely storied. Diffuse parenchyma with crystalliferous cells also present. Medullary rays 2-5 seriate, always homogeneous with typically short (procumbent) cells.

The present distribution of the families Anacardiaceæ, Dipterocarpaceæ and Leguminosæ is chiefly tropical. Their occurrence in fossil condition in South Arcot District indicates that the climate of the area at the time when these plants were alive was not very much different from what it is today.

The author is indebted to Dr. R. V. Sitholey for his kind help and suggestions.

Birbal Sahni Inst. of Palæobotany,
Lucknow, *May* 13, 1953.

C. G. K. Ramanujam.

1. Sahni, B., *Palæontologia Indica*, N. S., 1931, 11.
2.—, *Proc. Acad. Sci. U.P.*, 1931, 1.

STUDY OF SULFHYDRYL COMPOUNDS IN NEERA BY PAPER CHROMATOGRAPHY

That neera is a fairly rich source of sulfhydryl (SH) compounds, was reported by Guttikar and Sohonie.[1,2] The stability of ascorbic acid in neera has been attributed by them to the presense of 'SH' compounds. It was, therefore, felt of interest to study the nature of these 'SH' compounds by paper chromatography.

Freshly drawn neera was treated with equal volume of ethyl alcohol to remove pectinous material. The 'SH' compounds were then subjected to further purification by treatment with 6 per cent. mercuric nitrate.[3] The mercury complex was removed by centrifuging and it was then thoroughly washed with water. The precipitate was stirred in 10 ml. of N HCl and decomposed by passing H_2S gas. The black precipitate of mercury sulfide was removed and the filtrate obtained was treated with mercury nitrate again. The above procedure was repeated and the clear solution obtained was made free of H_2S by passing nitrogen gas through it, until the vapours gave no more positive test with lead acetate paper. The final 'SH' concentrate had a volume of 25 ml. approximately and was 0·5 N with respect to HCl. This solution was used for chromatography.

The technique as described by Giri and Rao[4] for circular paper chromatography was followed throughout the investigation. The paper used was 'Whatman No. 1' filter-paper, while the solvents used were (1) N-Butenol-acetic acid-water mixture in the proportion of 40 : 10 : 50 and the upper layer used in the trough; (2) phenol-water mixture in the proportion of 80 : 20; (3) iso-butric acid.

The papers were spotted with the above purified neera extract and with the standard solutions of glutathione and cysteine and they were irrigated with the above solvents. In all the cases, the solvents were allowed to travel for 4 hours. The papers were then removed and dried at room temperature. They were developed using the reagents mentioned in Table I.

The R_f values with the three different solvents are given in Table I, from which it will be seen that the values agree very well with those of glutathione.

Table I

	Butenol acetic acid-water (A)	Phenol-water (B)	Isobutric acid (B)
Std. Glutathione	0·38	0·66	0·54
Std. Cysteine	0·58	0·84	0·75
Neera extract	0·38	0·64	0·52

A : Developed with 0·1 % ninhydrin in N-butanol[5]
B : Developed with Iodine-Azide reagent[6]

Further proof was obtained when the purified neera extract was hydrolysed with HCl and the hydrolysate was studied by paper chromatography, whereby the component amino acids, glycine, glutamic and cysteine were identified.

Glutathione in neera was estimated by titration with p-chloro-mercury benzoic acid[7] using sodium nitroprusside as an indicator. The reagent is specific for the estimation of glutathione in biological material. The iodometric method[8] is useful to estimate the entire 'SH' compounds in the material containing ascorbic acid after deducting the iodine equivalent of ascorbic acid. It was observed that the value obtained for glutathione by titration with p-

chloro-mercury benzoic acid agreed well with the iodometric estimate of 'SH' compounds. It is, therefore, concluded that 'SH' compounds in neera exist entirely as glutathione.

The samples of neera were obtained through the courtesy of the President, Gandhi Smarak Nidhi, Bombay State.

Dept. of Biochemistry, KAMALA SOHONIE.
Inst. of Science, B. V. HATWALNE.
Bombay-1, *August* 6, 1953.

1. Guttikar and Sohonie, *Curr. Sci.*, 1952, **21**, 137. 2. —, *Proc. Ind. Acad. Sci.*, 1953, **37B**, 167. 3. Millar and Rockland, *Arch. Bioph. and Biochem.*, 1952, **40**, 416. 4. Giri and Rao, *Curr. Sci.*, 1952, **21**, 250. 5. Condson, Martin and Gordon, *Biochem. J.*, 1944, **38**, 244. 6. Chargaff and Green, *J. Biol. Chem.*, 1948, **175**, 49. 7. Hellerman, Chinard and Deitze, *Ibid.*, 1943, **147**, 443. 8. Mapson and Goddard, *Biochem. J.*, 1951, **49**, 593.

INDIAN BAUXITES FOR THE DEHYDRATION OF ALCOHOL TO ETHYLENE

THE use of certain naturally occurring bauxites and clays as catalysts for the dehydration of ethyl alcohol to ethylene is well known. Many references, some of which are given here[1–6] are available on the use of synthetic aluminas, bauxites and clays for this reaction. Little or no data have been reported on the specificity and capacity of Indian bauxites for this reaction.

Several Indian bauxites were tested for their specificity and activity in the catalytic dehydration of ethyl alcohol to ethylene. In tests carried out with a catalytic reactor having a capacity of 1 lb. of ethylene per hour, the conversions obtained with the 3 Indian bauxites mentioned below averaged better than 90 per cent. at space velocities even above 1 gm. of alcohol (expressed at 100 per cent.) per c.c. of catalyst per hour. The average unsaturated hydrocarbon content of this gas was 96 per cent.

These bauxites are from the Shevaroy Hills, Salem District, Madras State. According to the information available[7] the percentage composition of the dry samples lay between 53-58 Al_2O_3, 3-9 Fe_2O_3, 3-11 silica, the alumina being present as gibbsite and the impurities as mechanical admixtures.

The bauxites before use, were activated in a muffle furnace at 450° ± 10° C. for 4 hours.

With imported activated alumina catalysts, the same conversion (about 90 per cent.) could be obtained at space velocities up to about 0·75 g./c.c./hour. Higher space velocities resulted in lower conversions. However, these catalysts gave a higher percentage of ethylene in the product gas.

The majority of catalysts (both aluminas and bauxites) reported in literature had activities of a lower order than those observed by us with the above three Indian bauxites and hence they can be used advantageously in place of synthetic alumina. For instance, Bentley and Feacham[1] obtained an activated alumina catalyst that gave a conversion of 98 per cent. with alcohol feed rates up to 0·480 c.c./c.c. of catalyst/hour at 357° C.

The only reliable data on large-scale plant practice is contained in the BIOS Report No. 776[6] which reports a figure of 0·55 g./c.c./hour as the average space velocity used in catalytic converters using synthetic alumina and yielding over 90 per cent. conversion of alcohol to ethylene at 360° C.

The present investigation leads us to conclude that the three Indian bauxites specified herein can be used with advantage in industry in place of the more expensive synthetic aluminas for the catalytic dehydration of alcohol to ethylene.

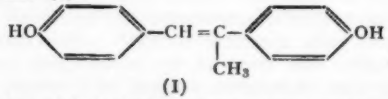
Life tests on these bauxites are in progress and we hope soon to publish the detailed data.

Chem. Engg. Div., M. U. PAI.
NCL, Poona-8, H. K. JOSHI.
August 17 1953.

1. Bentley, F. J. L. and Feachem, G. C. P., *J. Soc. Chem. Ind.*, 1945, **64**, 148. 2. Miller, H. S., U.S. Patent 2,378,236, June 12, 1945. 3. Murai, S. and Yokoyama, Y., *Waseda, Applied Chem. Soc. Bull*, 1941, **18**, 12. 4. Kearby, A. and Swann, S. (*Jr.*), *Ind. Eng. Chem*, 1940, **32**, 1607. 5. Miller, H. S., U.S. Patent 2, 377,026, May 29, 1945. 6. *Manufacture of Ethylene Oxide, Ethylene Glycols, Ethylene Chloride*, BIOS Report No. 776. 7. Private Communication.

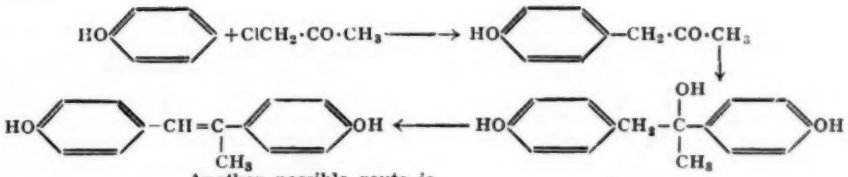
PREPARATION OF 4, 4'-DIMETHOXY-α-METHYLSTILBENE

THE product of condensation of chloroacetone with phenol in the presence of concentrated sulphuric acid has been reported from these laboratories[1] to be 4, 4'-dihydroxy-α-methylstilbene (I).

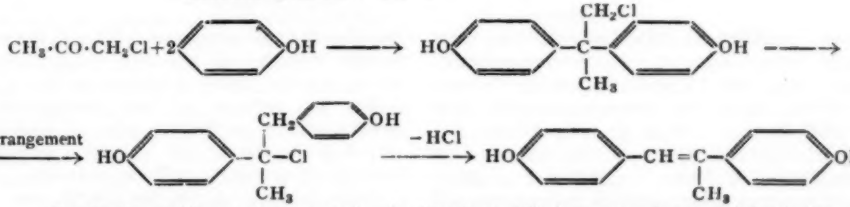


(I)

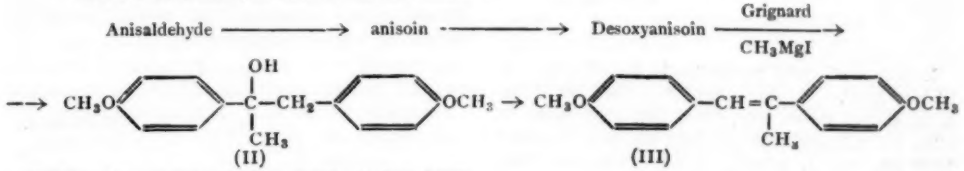
Carbon and hydrogen percentages agree with the formula (I); the product yields a dimethyl ether, m.p. 124-25° C., agreeing with that reported by Dodds, Golberg, Grunfeld, Lawson, Saffe and Robinson[2] for this compound. The following mechanism was suggested.[1]



Another possible route is



Synthetic evidence in support of structure (I) has now been obtained by preparing an authentic sample of 4, 4'-dimethoxy-α-methylstilbene following the method of Dodds, *et al.*,[2] as shown below:



During the course of this work, it has been noticed that in some cases when benzene is substituted for anhydrous ether at the Grignard stage and the reaction allowed to proceed at the boiling temperature of benzene for two hours, the product, on working up the reaction mixture in the usual way, is the stilbene derivative (III), and not the expected alcohol (II). This substance has been recrystallized from petroleum ether (b.p., 40-60° C.), and obtained as shining plates, m.p. 124-25° C. (Dodds, *et al.*,[2] reported 123-24° C.), and does not depress the melting point of the dimethyl ether of the condensation product obtained by Bhargava and Zaheer.[1]

It has thus been established that the condensation between chloroacetone and phenol under the conditions employed by Bhargava and Zaheer,[1] whatever the mechanism, leads to the formation of a stilbene derivative.

Full details of this and related investigations will be published in due course.

Central Lab. for Scientific and Industrial Research, Hyderabad-Deccan, *July* 1, 1953.

V. D. N. Sastri.
N. Shanmukha Rao.
S. Husain Zaheer.

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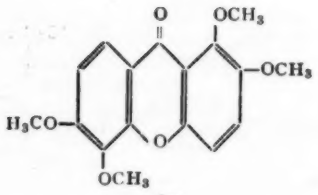
2. Dodds and co-workers, *Proc. Roy. Soc.*, **1944, 132B,** 87.

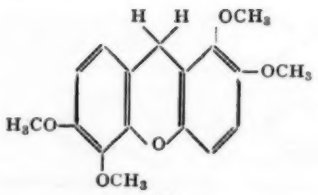
LITHIUM ALUMINIUM HYDRIDE AS A REDUCING AGENT FOR ANTHOXANTHINS

In continuation of our studies on the constitution of naturally occurring xanthones-decussatin and swertinin,[1] it has been found that methyl ether of decussatin on reduction with lithium aluminium hydride, gives a xanthene derivative, the CO-group being reduced to CH_2. This was rather unexpected because carbonyl compounds on reduction with this reagent generally give carbinols.[2] Mirza and Robinson who were the first to study the reduction of γ-pyrones by lithium aluminium hydride have reported their reduction to γ-pyronols. In the present case, the reduction goes a step further to the methylene derivative. In view of the anomalous result in the case of xanthone, this study was extended to some flavones which are also found to give flavenes. A few isolated observations have been made in the past wherein further reduction of carbinols to methylene derivatives has been reported.[4]

Decussatin methyl ether (I), b.p. 165° C., on boiling with excess of lithium aluminium hydride in ether for about 12 hours, gave the



(I)



(II)

xanthene derivative (II), crystallising from alcohol, m.p. 125-26° C. 4'-Methoxy-6-methyl flavone, m.p. 170° C., and 4'-methoxy flavone, m.p. 157° C., gave the corresponding flavenes, m.p. 130° C. and 123-24° C., respectively. A systematic investigation of the reduction of anthoxanthins with this reagent and synthesis of catechin-type compounds is in progress. A detailed account will appear elsewhere.

National Chem. Lab. of India, Poona-8, *July* 24, 1953.

A. B. KULKARNI.
R. C. SHAH.

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DISTRIBUTION OF PHOSPHOPROTEIN PHOSPHATASE IN MAMMALIAN TISSUES*

PHOSPHOPROTEIN phosphatase, an enzyme specific for the dephosphorylation of phosphoproteins was first detected in frog eggs by Harris.[1] The presence of a similar enzyme was reported in rat tissues by Feinstein and Volk[2] and by Norberg.[3] The enzyme had a wide distribution occurring in almost all the tissues, the highest activity being found in the spleen. These workers have also suggested an interrelationship between phosphoprotein phosphatase activity and tissue growth.[4-6] In the present investigation the distribution of the enzyme has been studied in some of the tissues of adult rat, rabbit, cattle, sheep and pig. By employing a purified preparation of the enzyme from ox spleen we have already shown that the enzyme in question acts specifically on phosphoproteins and has very little action on their proteolytic breakdown products or on glycerophosphate.[7]

The tissue extracts for the assay were prepared by grinding in a mortar a weighed amount of the freshly dissected tissue with ten times its weight of 0·5 M sodium chloride buffered at pH 5·6. The use of this medium facilitated the almost quantitative extraction of the enzyme besides ensuring its stability. After centrifugation of the tissue homogenate for a short period the activity of the supernatant was determined on a 0·5 ml. aliquot with casein as substrate and at pH 6 in the presence of 0·001 M thioglycollic acid as activator.[7]

Table I below shows the distribution of the enzyme in the various tissues examined. Enzyme activity has been expressed in terms of micrograms of phosphorus liberated in 30 min. from a solution of casein containing 10 mM of organic phosphorus.

TABLE I

Species	Tissue	Activity per g. fresh tissue
Cattle ..	Spleen	1182
	Liver	1126
	Kidney	734
Sheep ..	Spleen	1386
	Liver	882
	Heart	412
Pig ..	Spleen	1236
	Liver	1302
	Kidney	1236
Rat ..	Spleen	4068
	Liver	1484
	Kidney	1526
Rabbit ..	Spleen	1868
	Liver	714
	Kidney	608

It will be evident from the results that the highest enzyme activity is found in rat spleen. The results obtained in the case of rat tissues are quite comparable to those obtained by Feinstein and Volk[2] who employed 0·01 M ascorbic acid as activator in their studies. Rat spleen was, however, only slightly more active than the liver according to Norberg.[3] No activator was used by Norberg in his experiments and this may possibly explain the low results obtained with spleen.

The distribution of the enzyme in other animal tissues has been presented here for the

first time. It is of interest to note that animal tissues contain small but significant amounts of phosphoprotein.[6,8,9] This fraction shows a very high rate of uptake of P^{32} and is thought to be an important intermediate in the utilization of phosphate.[9–11] The co-existence of phosphoprotein phosphatase and its natural substrate in animal tissues suggests that the enzyme may be concerned in the dephosphorylation of tissue phosphoprotein and hence phosphorus turnover of this substance. This is further confirmed by the recent findings of Johnson and Albert[9] who report the highest phosphoprotein content in rat spleen—the tissue in which the highest phosphoprotein phosphatase content occurs. These workers were, however, unable to establish any close relationship between phosphatase activity and protein phosphorus turnover in the tissues. This discrepancy might, according to them, be explained on the basis that an inhibitory mechanism for the enzyme exists *in vivo* that is not active *in vitro*. Verification of this interesting hypothesis would undoubtedly throw further light on the exact physiological role of the enzyme.

T. A. Sundararajan.
P. S. Sarma.

University Biochem. Lab.,
Madras-25, *September* 10, 1953.

* Part of work carried out by one of us (T.A.S.) for the M.Sc. Degree during the tenure of a University research studentship.

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BARBIER-WIELAND DEGRADATION OF TRICYCLOEKASANTALIC ACID

In connection with certain investigations on sandalwood oil, the author required nor-tricyloekasantalic acid. This acid had been prepared by Semmler[1] from α-santalol by ozonolysis and subsequent permanganate oxidation of the enol-acetate of the resultant tricycloekasantalal. As the isolation of pure α-santalol requires repeated fractionation (of the alcoholic portion of sandalwood oil) and further purification of the α-santalol fraction so obtained, through the strychnine salt of its hydrogen phthalate, this method appeared to be tedious. It has now been prepared by the Barbier-Wieland degradation[2,3] of tricycloekasantalic acid which is a readily available crystalline compound.

Ethyl tricycloekasantalate [b.p., 110-11°/1·5 mm.; $n^{23°}$, 1·4715; $(\alpha)_D$ + 12·27° (chloroform, l = 5 cm., C = 3·258)] gave on treatment with phenyl magnesium bromide a viscous tertiary alcohol, $C_{24}H_{28}O$ (b.p., 184-86°/1·2 × 10^{-2} mm. Found: C, 86·57; H, 8·23. $C_{24}H_{28}O$ requires C, 86·70; H, 8·43 per cent.) which underwent dehydration with acetic anhydride and furnished an unsaturated hydrocarbon $C_{24}H_{26}$ [b.p., 180-5°/1·5 mm.; $n^{23°}$, 1·5855. Found: number of double bonds, 1·035 (per benzoic acid method), C, 90·81; H, 8·35. $C_{24}H_{26}$ requires C, 91·70; H, 8·28 per cent.]. On ozonolysis in ethyl acetate medium this unsaturated hydrocarbon gave free nor-tricycloekasantalic acid and nor-tricloekasantalal (b.p., 80-85°/5 mm.; semicarbazone, m.p. 223-24°; Found; C, 65·24; H, 8·30; N, 19·2. $C_{12}H_{19}N_3O$ requires C, 65·16; H, 8·6; N, 19·0 per cent.) along with benzophenone, unreacted hydrocarbon and a solid by-product, m.p., 116°, which was found by periodate test to be a 1, 2-diol, $C_{24}H_{28}O_2$ [Found: M.W. (Rast method), 346·4; C, 82·03, 82·08; H, 8·40, 8·34. $C_{24}H_{28}O_2$ requires M.W., 348; C, 82·75; H, 8·04 per cent.]. The nor-tricycloekasantalal was oxidised with alkaline silver oxide by Delepine and Bonnet's method[4] to nor-tricycloekasantalic acid. The overall yield of nor-tricyloekasantalic acid [m.p., 93°; $(\alpha)_D$ − 23·1° (alcohol, l = 5 cm., C = 1·712). Found: Eq. wt., 179·4; C, 73·59; H, 8·90. $C_{11}H_{16}O_2$ requires Eq. Wt., 180; C, 73·33; H, 8·88 per cent.] was about 64 per cent. of the unsaturated hydrocarbon.

The author thanks Dr. B. H. Iyer for his kind interest in this work.

Dept. of Organic Chemistry, A. Bhati.
Indian Institute of Science,
Bangalore-3,
September 21, 1953.

1. Semmler, *Ber.*, 1910, **43**, 1722. 2. Barbier and Lacquin, *Compt. Rend.*, 1913, **156**, 1443; *J. C..S: Abst.*, i, 1913, **104**, 700. 3. Wieland, Schlichting and Jakobi, *Z. physiol. Chem.*, 1926, **161**, 80; *Am. Chem. Abst.*, 1927, **31**, 590. 4. Delepine and Bonnet, *Compt. Rend.*, 1909, **149**, 39; *J. C. S. Abst.*, i, 1909, **100**, 632.

ESTIMATION OF SULPHIDE, SULPHITE AND THIOSULPHATE BY CHLORAMINE-T

THE method of Kurtenacker and Wollack[1] for the analysis of a mixture of sulphide, sulphite and thiosulphate, using standard solutions of iodine and thiosulphate only, is simple and rapid; but, it does not yield very accurate results at very low concentrations of sulphide and thiosulphate since the consumption of iodine by each mole of these corresponds only to two and to one equivalents of iodine respectively.

It has been shown in an earlier communication[2] that hydrogen sulphide is quantitatively oxidised to sulphuric acid by chloramine-T in acid medium. Further investigations have revealed that thiosulphate is also oxidised to sulphate quantitatively under similar conditions. Thus, when chloramine-T is employed as an oxidising agent in an acid medium, both sulphide and thiosulphate are quantitatively oxidised requiring 8 equivalents of the oxidant for complete oxidation according to the equations:

$$Na_2S + 4\ O \longrightarrow Na_2SO_4$$

$$Na_2S_2O_3 + 4\ O + H_2O \longrightarrow Na_2SO_4 + H_2SO_4$$

The accuracy of the method should, therefore, be enhanced considerably both in the case of sulphide and thiosulphate. This was actually found to be the case. A brief account of the method developed on the above lines as well as the results obtained are given below.

An aliquot of the solution containing sulphide, sulphite and thiosulphate of sodium is added to a stoppered flask containing a known excess of chloramine-T (0·1 N) in 2 N sulphuric acid and shaken for about 5 minutes to effect complete oxidation of the sulphur compounds. The excess of chloramine-T is then estimated by the addition of potassium iodide and titrating the liberated iodine against standard thiosulphate solution.[3] Thus, the quantity of chloramine-T consumed for the oxidation of sulphur compounds is determined (x).

To another aliquot, a freshly prepared alkaline cadmium hydroxide suspension is added to precipitate the sulphide as cadmium sulphide. The precipitate, after filtration and washing, is oxidised in an acid medium by chloramine-T and the amount of oxidant consumed is determined as described above (y). The filtrate from the above precipitate containing both sulphite and thiosulphate is acidified and treated with a solution containing a known excess of iodine. The sulphite is oxidised to sulphate and thiosulphate is converted into tetrathionate quantitatively. The excess of iodine is titrated against thiosulphate and the amount of iodine required for such a reaction is easily obtained. The corresponding quantity of chloramine-T is readily calculated (z).

From the above data, it can be shown that if a, b and c are the number of moles of sulphide, sulphite and thiosulphate that are present in the mixture, then

$$8a + 2b + 8c = x;\ 8a = y;\ \text{and}\ 2b + c = z$$

from which the values of a, b and c can be calculated. The results of a few representative estimations are given in Table I.

TABLE I

Analysis of the mixture of sulphide, sulphite and thiosulphate solution

Component	Quantity taken*	Quantity estimated			
		Kurtenacker-Wollack method	Error	Chloramine-T method	Error
Sulphide	12·56	12·22	−2·8	12·48	−0·6
	5·74	5·68	−1·0	5·71	−0·5
	1·38	1·31	−5·1	1·36	−1·4
Sulphite	14·84	14·76	−0·4	14·79	−0·3
	4·95	4·89	−1·2	4·92	−0·6
	1·27	1·25	−1·4	1·28	+0·8
Thiosulphate	49·58	48·96	−1·2	49·39	−0·4
	15·36	14·96	−2·6	15·26	−0·6
	4·54	4·32	−2·6	4·50	−0·9

* Quantities of sulphur compound taken are expressed in terms of mg. of sulphur.

It can be readily seen from Table I that the present method gives more accurate results than the earlier one. Using N/100 chloramine-T and a standard solution of thiosulphate, it is possible to analyse very dilute solutions of a mixture of sulphide, sulphite and thiosulphate.

The author wishes to express his grateful thanks to Prof. K. R. Krishnaswami and Dr. M. R. A. Rao for their kind interest in the work.

Dept.. of Gen. Chem., A. R. VASUDEVA MURTHY.
Indian Institute of Science,
Bangalore-3,
September 21, 1953.

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RIBOFLAVINE AND THIAMINE CONTENTS OF GUMS

GUMS are valuable commercial commodities which have found very varied industrial and medicinal uses. They are believed to be astringent and anti-dysenteric; expectorant; tonic to the liver and known to enrich blood. Gum 'Babul' or the gum from *Acacia arabica* Willd. is particularly administered during pregnancy in the Konkan and Maharashtra in the form of a strengthening sweetmeat, mixed with sugar.[1] It was this latter use which suggested an analysis of some gums procured locally for their riboflavine and thiamine contents. A similar analysis of saffron which had yielded promising results has been reported elsewhere.[2]

Twelve gum samples were analysed for the presence of riboflavine and thiamine by use of the fluorimeter. An acetic acid buffer (pH 4·5) extract of gum to which papain and taka-diastase were added was taken. After allowing hydrolysis to proceed for 18 hours at 42° C., the enzymes were destroyed by heating the extract. The latter was filtered and an aliquot adjusted to pH 3·7 was treated with 4 per cent. potassium permanganate and hydrogen peroxide in order to destroy the pigment in the extract. The fluorescence of the filtrate thus obtained was read on a fluorimeter. A correction for fluorescent substances other than riboflavine was made in each case by adding a little sodium hydrosulphite to the extract and reading the fluorescence again.

Another aliquot of the acetic acid buffer extract was treated with alkaline potassium ferrocyanide and isobutyl alcohol whereby the thiamine was oxidised to thiochrome[3] and was estimated in the isobutyl alcohol layer by use of the fluorimeter.

TABLE I

Sample	Trade name of gum	Source	Riboflavine γ/g.	Thiamine γ/g.
1	Babul	*Acacia arabica* Willd.	79·6	8·42
2	Ghatti	*Anogeissus latifolia* Wall.	68·92	0
3	Karai*	*Sterculia urens* Roxb.	17·4	0
4	Karai*	,,	31·0	0
5	Palas	*Butea monosperma* Kuntze	138·8	4·28
6	Semala	*Bombax ceiba* Linn.	178·6	24·28
7	African	*Acacia* sp.	53·2	0
8	Swakin	,,	54·2	11·42
9	Talu	,,	78·6	0
10	Maklai	,,	60·2	0
11	Gelatin powder Belgian SPA		60·2	0
12	Arabic	*Acacia* sp.	46·6	0

*Two different sources.

The results of the analysis are presented in Table I.

It will be noticed that the gums analysed are very rich in riboflavine, particularly samples 1, 5, 6 and 9. These are edible and important medicinally. Thiamine was found to be present in amples 1, 5, 6 and 8, the richest sample being that of 'Semala' gum.

The authors thank Messrs. Hortus Indicus and Messrs. Kala Gandhi for supplying the gum samples and are grateful to Dr. H. R. Pithawalla and Mr. S. B. Dhungat of the University Department of Chemical Technology, Bombay, for their assistance in taking the readings.

St. Xavier's College, Dept. of Microbiology, Bombay, *August* 12, 1953.

RAJUL BROKER.
J. V. BHAT.*

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PSEUDOBRANCH IN *MASTACEMBELUS*

So far as the author is aware, pseudobranch has not yet been described in the family Mastacembelidæ. Day[1] describes the absence of pseudobranch as a diagnostic character of the family Mastacembelidæ and Boulenger[2] also mentions its absence in the family. Job[3] has also not made any reference to pseudobranch in *Mastacembelus*. During the course of studies on *Mastacembelus armatus* and *M. pancalus*, however, it was found that the pseudobranch is present in both the species. The observations are based on a study of the structure in the embryo as well as in the adult.

The pseudobranch is well developed in embryos over 10 mm. in length. In a typical transverse section of the embryo of *M. armatus* 21·6 mm. in length, the pseudobranch is seen as a large and prominent structure which projects into the oral chamber from the inner margin of the hyoid arch near its upper end (Fig. 1). Due to this, a narrow inpushing of the oral chamber is formed between the upper edge of the pseudobranch and the lateral border of the roof of the oral chamber which may be called

as suprapseudobranchial chamber. The epithelial lining of this chamber consists of greatly flattened cells, and the capillaries of the pseudobranch approach close to these cells; at other places the capillaries do not lie close to the lining of the oral chamber but are separated

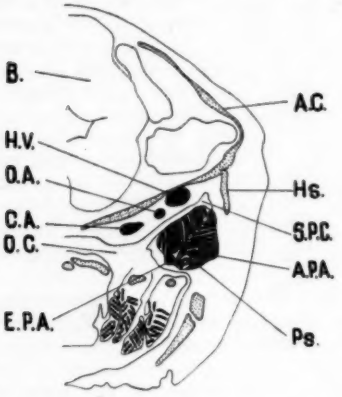

FIG. 1. T. S. Embryo of *Mastacembelus armatus* (21·6 mm. in length) passing through the region of pseudobranch.

A.C., auditory capsule; A.P.A., afferent pseudobranchial artery; B., brain; C.A., carotid artery; E.P.A., efferent pseudobranchial artery; Hs., hyosymplectic cartilage; H.V., head vein; O.A., orbital artery; O.C., oral chamber; Ps., pseudobranch; S.P.C., supra pseudobranchial chamber.

from it by the normal epithelial cells and connective tissues. In the pseudobranch there are no free branchial lamellæ like that of a functional gill, but the entire organ presents a compact structure traversed by numerous capillaries, through which the blood from the afferent pseudobranchial artery passes into the efferent pseudobranchial artery. The orbital artery emerging from the carotid runs forward upto the anterior end of the pseudobranch where it gives a hyoidean artery and then continues as the afferent artery of the pseudobranch. The efferent artery from the pseudobranch runs forward upto the posterior margin of the eye where medially it is joined by a short branch with the fellow of the opposite side; it then passes round the external carotid and runs as the ophthalmica magna artery to the choroid gland of the eye. The structure described is pseudobranch, because it receives aerated blood from the carotid artery. The pseudobranch is supplied by a branch of the ninth cranial nerve, and this shows that the structure is a hyoidean pseudo-branch and not a spiracular one.

In the adult fish, in front of the first branchial arch, the roof of the oral chamber shows a small depression on either side near its lateral border. This represents the opening of a small chamber which has been described before as present in the embryo. On slitting open this chamber and removing the lining of the oral chamber lateral to the depression, the pseudobranch is seen as a small oval structure. In fresh condition it is visible as a reddish spot even through the lining of the oral chamber, but the colour is lost in preserved specimens.

Thus a pseudobranch is present even in the adult *Mastacembelus* though it is proportionately much reduced in size than in the embryo. In an adult *M. armatus* measuring about 1½′ in length, the structure is about 3 mm. in length. In transverse sections, the pseudobranch shows a structure closely resembling that of the embryo and consists of a mass of blood capillaries resembling a *rete mirabile*. The pseudobranch was so far not recorded in adult probably because it is hidden below the buccal epithelium and is colourless in preserved specimens.

The suborder, Opisthomi, includes only a single family Mastacembelidæ and this is probably derived from the family Blenniidæ. This affinity is further supported by the presence of pseudobranch in the genus *Mastacembelus*. Further work will probably show that similar pseudobranch is present in *Rhynchobdella* which is the only other genus included in the family Mastacembelidæ.

The author offers his sincere thanks to Dr. D. S. Srivastava for his kind guidance and interest in the work.

Dept. of Zoology, H. N. BHARGAVA.
University of Saugar,
Sagar, M.P., *June* 27, 1953.

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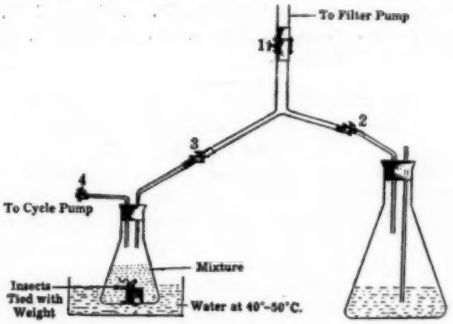
A NOTE ON THE STUDY OF INSECT TRACHEAL SYSTEM

STUDENTS of insect morphology are well acquainted with the difficulties encountered in a detailed study of the tracheal system. Several methods have been tried to make the tracheal branches easily perceivable. Harshberger[1,2] injected the living insects with intra-vitam stains, Hagmann[3] used aqueous stains under low pressure created by a vacuum pump. Both these were tried by us but the results were not upto

the mark. We found Krogh's[4] method with some modification more successful. But Krogh did not mention the proportions of the constituents used by him. Various proportions were, therefore, experimented upon by us, and the one mentioned below gave the best result.



Oil of Turpentine—1 part by vol.
Bee's wax (melted)—½ part by vol.
Paraffin wax (melted, m.p. 56-58° C.)—½ part by vol.

The mixture was coloured with red oil colour dye of I.C.I. instead of *alkanna* root which takes nearly a week and was also not available here. A pinch of the dye in 20-25 c.c. of turpentine gave a bright colouration. Then filtered bee's wax and paraffin were added to the mixture, which was well shaken and placed in the embedding bath for two hours. This mixture melts nearly at 41-43° C., and gives satisfactory results even without addition of colophoneum.

The writers agree with Krogh that water and watery mixture are not very effective in penetrating the trachea.

The solidified mixture was placed in a small flask (250 c.c.) and a number of narcotized small insects were put into the flask tied by means of a thread to a small weight, so as to prevent them from floating on the surface of the liquid. The apparatus as detailed in figure above was connected with an ordinary filter-pump. The flask was then evacuated of air for 10-20 minutes after which it was immersed in hot water at a temperature of 40-50° C. and the evacuation continued for another 5-10 minutes. By this time the mixture melted causing the insects to float submerged. Then stopper No. 1 was closed and stopper No. 2 opened slowly to admit air into the flask. This was done in several instalments so as to ensure better penetration of the liquid. On reaching equilibrium, the pressure inside the experimental flask was increased by pumping air through a cycle pump and valve, and a high pressure was maintained for 5-8 minutes. After this the material was taken out and immediately transferred to cold water. Krogh did not increase the pressure inside the experimental flask after the equilibrium was restored. But the authors found that increasing the pressure helped in a better penetration of the mixture into the finer tracheal branches. The excess of the mixture sticking on the surface was removed with a brush dipped either in xylol or ether. The whole tracheal system of the treated insects, including its branches was permeated by the mixture and was coloured red, and could be studied with comparative ease under a binocular microscope. If required these specimens can be preserved in formalin or 70 per cent. alcohol.

Zoology Department, S. C. VERMA.
University of Allahabad, AMAR N. CHATTORAJ.
Allahabad, *August* 11, 1953.

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SEX CHANGES IN A WOOD-BORING BIVALVE MOLLUSC, *MARTESIA STRIATA* LINN.

THE phenomenon of sex-reversal has been reported in some of the wood-boring molluscs such as *Bankia*,[1] *Teredo*[2] and *Xylophaga*.[3] Coe[4] has recently given an excellent review on the subject. While investigating the biology and systematics of the wood-boring organisms in the Visakhapatnam harbour we examined the gonads of 130 specimens of the common local wood-boring bivalve, *Martesia striata* belonging to various size groups. The greatest antero-posterior length of the shell of each individual was measured and the condition of gonad ascertained. The results are tabulated below:

Size	Total No. examined	Males	Hermaphrodites	Females
1–10 mm.	16	15	..	1
10–15 ,,	27	6	5	16
15–25 ,,	80	12	30	38
25–30 ,,	22	5	7	10
30–35 ,,	14	4	2	8

It will be seen that of the 16 forms not exceeding 10 mm. in length, all were males with the exception of one female. In the size group

between 10-15 mm. five hermaphrodite specimens were found indicating a change of sex from male to female. It was noticed that in this size group the gonad contained more of spermatozoa and only a few ripe or unripe eggs. In the third size group between 15-25 mm. typical hermaphrodites were observed in which both the spermatozoa and ripe ova are well represented. In the fourth size group between 25 and 30 mm. the hermaphrodite forms are still represented, but the females are more in number than the males. The same condition was observed in the last size group where males and females were in the ratio of 1 : 2.

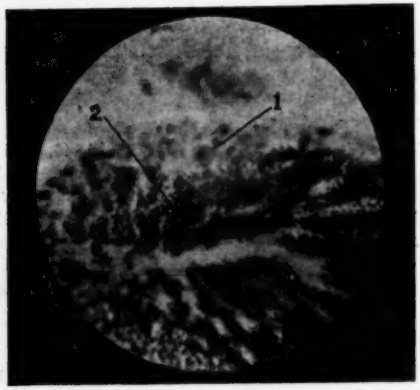

FIG. 1. Photomicrograph of T. S. of gonad of a hermaphrodite *Martesia striata*. 1. Egg, 2. Sperms.

From the above data it appears that *Martesia striata* is a protandric hermaphrodite,[5] the young specimens being males, and the change to female taking place when the animal attains a length of about 15 mm. This change may apparently be delayed in some cases and, therefore, animals of medium length showed all the three sexes. It is possible that individuals may undergo more than one change of sex, so that the largest size group may consist of individuals which are females for the second time. Examination of sections of gonads of specimens belonging to various size groups confirmed these observations.

We have also examined the gonads of several specimens belonging to various size groups of *Teredo navalis* and *Teredo digensis* and are in a position to confirm the finding of Coe[2] and Grave[6] regarding the sex reversal in this genus.

Fuller details will be given in a comprehensive paper under preparation.

Dept. of Zoology, Andhra University, Waltair, *August* 25, 1953.

P. N. GANAPATI.
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INVESTIGATION OF RIBO AND DESOXYRIBONUCLEIC ACID IN CYANOPHYCEAE

GARDNER[1] AND SPEARING[2] have contributed a great deal of factual and descriptive knowledge of cytological phenomena in this group. But the chemical nature of the central body is yet to be found out.

Various staining methods were tried to determine the exact nature of the central body in this Group (*e.g.*, crystal violet, hæmatoxylin, siemsagelie, thionin, acetocarmine, aceto-orcein, acetolacmoid, etc.). With crystal violet and hæmatoxylin a well differentiated central body was noticed in almost all the species tried for.[2] Different samples of basic fuchsin (Grubler, Harleco, Gurr) were also tried, but no promising results have yet been achieved. The slight colouration of the central body by feulgen is however noteworthy.

The differential staining of RNA and DNA by an aqueous mixture of methyl green and pyronin at a suitable pH is well known (Brachet,[3] Kurnick,[4] Chayen,[5] Sarma and Bhattacharjee[6]). The standard method, described by Darlington and LaCour,[7] with variation in fixation and staining has been tried. Different fixatives (*e.g.*, Carnoy's fluid, acetic alcohol, osmic acid, Serra's solution, Nawaschin solution, etc.), have been used to see the deviations. Some slides are stained after hydrolysis in N HCl at 60° C. for varying periods (experimentals). The proportions of methyl green pyronin in staining solution was increased from 3 : 7 to 7 : 3 gradually.

The central body does not take methyl green stain at all in any of the experimentals and controls tried. In the controls the cytoplasm is also stained ; the cytoplasm is less stained after 5 minutes' hydrolysis. After 10 minutes' hydrolysis the cytoplasm is almost clear but the central body retains the purple colour. As the timing of hydrolysis is increased, the intensity of the stain decreases. After 30 minutes' hydrolysis the stain in the central body becomes very much faint. Similar was the result when

0·25 M. trichloro-acetic acid was used for hydrolysis at 65° C. showing that it is as effective in bringing about the same kind of changes within the cell. With differept fixatives only a deviation in the colouration of the central body from purple to reddish violet was obtained. The purple colouration, developed in the central body with the above stain technique even after hydrolysis indicates the presence of RNA type. A similar result was reported by Hoffman[8] with Fuso-bacteria.

When only pyronin (G) is used the central body takes an intense purple colour within 5 minutes. With purified methyl green (Merck) the cell takes bluish colouration and the central body is differentiated by slightly deeper but uniform staining. After staining in methyl green overnight, if the slides are kept in pyronin for 5 minutes, the central body takes the purple colouration. The differentiation in buffer solutions and 95 per cent. alcohol overnight, does not restore the previous bluish colouration of the central body. Chayen's method[5] was followed to see whether the methyl green colouration is overlapped by pyronin due to sheer competition, but the restoration of the bluish colouration after differentiation has not been obtained.

0·5 per cent. methyl green and pyronin solutions in 0·2 M. acetate buffer (pH 4·28) were used in this case. Mostly the work was done on Oscillatoria and Calothrix species.

From the above experiments it is noted that the central body has a greater affinity for pyronin stain. This indicates the presence of RNA or DNA in less polymerised condition. It is quite likely that DNA has not been highly polymerised in this lower group.

For further clarification in this matter the constituents of the nucleic acids should be sought for, which is now in progress.

I express my deep gratitude to Professor Y. Bharadwaja for his guidance and criticism and to Dr. R. N. Singh for his suggestions and advice.

Dept. of Botany, B. B. Biswas.
Banaras Hindu University,
Banaras-5, *June* 23, 1953.

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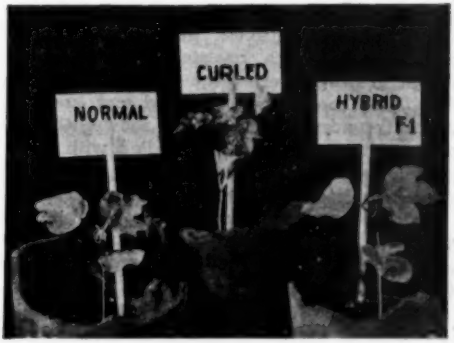
A CURLED-LEAF MUTANT IN HERBACEUM COTTON

A PLANT with its leaves curled upwards and inwards was observed as a solitary variant in a yield trial plot of the 2087 variety of herbaceum cotton in the 1951 season at the Agricultural Research Station, Surat. Strain 2087 is derived from the backcross (1027-A.L.F. × Vijay) Vijay. The new plant (see Fig. 1) resembled its sister-plants in other morphological characters. While it bred true to type, its crosses with normal-looking sister-plants gave fully normal F_1 plants. In the F_2 there was a monogenic segregation of 1073 normal : 352 curled ($X^2 = 0·07$), indicating that the abnormality was due to a recessive gene. The curly character of the leaves appears to be the result of a mutation as no such plant had been maintained or observed at this Station.



A similar curled leaf-plant was found in the 1027-A.L.F. (herbaceum) variety, in the 1952 season, by a colleague (Shri N. D. Desai). A cross between the two curled leaf mutants resulted in curled-leaf plants indicating the identity of the locus at which the mutation occurred in the two varieties.

Chi Pao Yu[2] reported a similar mutation, Curly Leaf, Cu, in the Asiatic (arboreum) cotton variety "Small White Flower". The plants under discussion resembled Yu's mutant in characters of leaves except that the leaves were dimpled (not smooth). However, the reduction reported by him in the size of flowers, bolls and seeds and in germination capacity was absent. An additional character observed was the distinctly finer feel of their lint.

Microscopic examination revealed that the palisade cells in the curled leaf were narrower and more densely packed and also contained more chloroplasts. The lint fibres were appreciably thinner. Very probably, the thinness of

fibres, which were found to be equally mature in technological tests as those from normal plants, is responsible for the finer feel of lint, as reported by Nanjundayya.[1]

The identity of the locus of the present mutation with Cu, is being tested by studying its linkage relationships.

Our thanks are due to Shri M. U. Parmar for technological tests of fibre maturity.

Agri. Res. Station, Surat, *July* 1, 1953. N. R. BHAT. K. D. KHATTAR.

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A *TRICHODERMA* DISEASE OF HONEY BEES

SOME dead bees were collected from an apiary near Jorhat in July 1952. The owner complained that all of a sudden the large number of his bees died while the rest had fled away. The dead bees collected were examined with a hand lens which revealed the presence of fungal growth covering the bodies of the dead bees. Such bees when dissected and examined carefully under the microscope showed that the walls of the stomach were riddled with fungal growth and in badly infested ones, the tissues were completely disintegrated.

A large number of isolations was made and a species of *Trichoderma* was always obtained in culture. It was identified as *T. lignorum* (Tode) Harz.

Inoculation experiments were carried out on bees kept in cages with the pure culture of the fungus. Spores of the fungus were either mixed with sterile water and then sprayed on the bodies of the bees with an atomizer, or were mixed with their food (dilute sugar solution) and the bees allowed to feed on it. In both cases infection took place and the bees developed a disease and ultimately died.

The first symptoms of infection were weakening, restlessness and continued effort on the part of the bees to escape. Later, the affected bees started crawling, lost one or more legs. The first crawlers appeared in 1-3 days depending upon the virulence, rate of growth of the fungus and the quantity of inoculum used. Death occurred within a few hours after the commencement of crawling.

So far, no such disease of honey bees appears to have been reported from any part of India. Fielitz[1] from Germany and Nicolls[2] from Tasmania, however, have reported diseases of bees caused by species of *Trichoderma* and other fungi.

Further studies are in progress and a detailed report will appear elsewhere.

Mycologist, Jorhat, Assam, *July* 13, 1953. S. CHOWDHURY.

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INHERITANCE OF LOBED LEAF MARGIN IN *MUNG* (*PHASEOLUS AUREUS* L.)

THE *Mung* leaves are trifoliate with long petioles. Generally the leaflets have entire margin, but rarely types with tri-blood leaflets are also met with. In Uttar Pradesh types with lobed leaf-margin are not found at all.

In crosses between a lobed leaf type, 41 D-I, and other types with entire leaf-margin, *viz.*, T I, T 48-6 and T 49-8, the lobed leaf character has been found to be dominant in F_1. In F_2 the results shown in Table I were obtained:

TABLE I

Cross	No. of plants with lobed leaf margin	No. of plants with entire leaf margin	Total No. of plants	Chi-square (3 : 1)	P Value
41D–IXT.1	343	99	442	1·5958	0·20 to 0·30
41D–IX48–6	412	138	550	0·0024	0·95 to 0·98
41D–IX49–8	266	109	375	1·9003	0·20 to 0·30

The above data give a food fit to a 3 : 1 ratio as the chi-square value is not significant. Thus the two characters, *viz.*, lobed *vs.* entire leaf-margin are controlled by one major gene difference.

The above finding is further substantiated by the F_3 data. Out of 21 lobed leaf type F_2 individuals grown in F_3 7 bred true for the lobed leaf type character and the other 14 individuals segregated into lobed and entire leaf-margin plants in a 3 : 1 ratio. Six F_2 individuals with entire leaf-margin were also grown in F_3. All these individuals bred true for the entire leaf-margin character.

From the above data it is concluded that "lobed leaf-margin" is dominant over "entire leaf-margin" with a monogenic difference. The 'entire leaf-margin' is designated by the symbol 'e' and the 'lobed leaf-margin' as 'E'.

Govt. Res. Farm, Kanpur, U.P., *September* 8, 1953. DHARAMPAL SINGH. T. R. MEHTA.

REVIEWS

Encyclopedia of Chemical Technology, Vol. IX. By R. E. Kirk and D. F. Othmer. (Interscience Publishers, New York), 1952. Pp. xvii + 943. Subscription Price $ 25 per copy. Single copy $ 30.

"Kirk and Othmer" has now become a familiar name to all students and research workers in chemistry, pure and applied, more particularly the latter. The previous volumes in the series have been very well received and appreciated. The present Volume No. 9, keeps up the standard expected. It covers the alphabetised subjects ranging from "Metal surface treatment" to "Penicillin". As in previous volumes, it is authored by mostly American scientists drawn from the leading Universities and research institutions as well as from well known and reputed industrial organisations such as The American Cyanamide Co. (Nitro benzene and nitro toluene), Blaw Knox Construction Co. (Oxo and oxyl processes), Squibb Institute of Medical Research (Penicillin), General Aniline and Film Corp. (Nitroso dyes, etc.), John's Manville Research Centre (Mineral Wool), International Nickel Co. (Nickel and nickel alloys), Bell Telephone Laboratories (Metal surface treatment), West Virginia Pulp and Paper Co. (Paper coatings), Commercial Solvents Corporation (Nitro alcohols), Du Pont De Neumoirs Co. (Nitro paraffins), Monsanto Chemical Co. (Packages and packaging), Rohm and Hass (Methyl amines), Hoffman La Roche (Pantothenic acid, etc.). The experiences of the University and research men and the practical wisdom of those engaged in the leading industries give the articles an authority that creates confidence in their contents and presentation. Many articles, depending on the nature of the subject, get a coverage of nearly 30 pages and are suitably illustrated with well printed diagrams.

An interesting aspect of "Kirk and Othmer" is that the pure science subjects are as well thoroughly covered as the applied science subjects, so that one is tempted to ask whether these volumes should not be styled as "Encyclopedia of Science and Technology". There are practically no errors to be detected in this volume. One is however amused to read in a volume printed in 1952, that Mysore and Coorg are in British East Indies (p. 589). This only shows that in spite of the world becoming "smaller" there are limitations to our knowledge of geography.

There is no doubt that "Kirk and Othmer" is a 'must' for the industrial, University and public libraries in spite of its rather heavy cost.

M. A. G. RAU.

Encyclopedia of Chemical Technology, Vol. X. *Pentacene to Polymethine Dyes.* Edited by R. E. Kirk and D. F. Othmer. (Interscience Publishers, Inc.), 1953. Pp. 976. Price $ 25.00.

As stated by the publishers, the Kirk-Othmer Encyclopedia presents a comprehensive summary of industrial knowledge on materials, methods, processes, and equipment for the chemist and the chemical engineer. This claim is fully justified and generally recognized; Kirk-Othmer has therefore become a necessary addition to the library of institutions concerned with any branch of chemical technology. The emphasis throughout is on commercial, practical and technological aspects. The chemical treatment is somewhat elementary, in comparison for instance with Thorpe's Dictionary.

The present volume maintains the standard of its predecessors. The articles on various topics have been written by experts chosen largely from American industry, and have obviously been submitted to careful editorial coordination, since there is much more uniformity than in Thorpe's Dictionary concerning the scope, presentation and readability. The articles on Phthalic Acids, which contains the interesting prophecy that isophthalic acid will grow to exceed phthalic anhydride in production volume and be lower than it in price, and those on Pilot Plant, Plant Location, Photography and Photochemistry are typical of the high quality of the Kirk-Othmer Encyclopedia and of its great value to every chemist.

A few minor omissions may be noted. In the article on pigments (organic) there is no reference to the important paper of Glassman in the *J. of the Oil and Color Chemists Association* (1950, **33**, 191). The article on Phthalocyanine Dyes does not mention recent developments in their application to textiles, such as Alcian Blue, Indanthrene Brilliant Blue 4 G and Phthalogen Blue IF3G. In the article on phloroglucinol "trihydrazone" should read as "trioxime".

The article on Polymethine Dyes, written by two members of the Kodak Research Laboratories, is excellent within the limits of the space allotted to it, but it is regrettable that the editors could not be persuaded to provide at least five times this space, considering the scientific and technical interest of the polymethines.

K. V.

Colliery Surveying. By R. McAdam. (Oliver & Boyd), 1953. Pp. vii + 145. Price 12 *sh.* 6 *d.*

This text-book on Colliery Surveying has been prepared to meet the requirements of students studying for the Colliery Managers and Undermanagers' Certificates of Competency and the new National Certificates in Mining.

The work includes levelling, chain and compass traversing, the use of simple vernier theodolites and mining problems on areas and volumes and structural geology of carboneferous strata.

The construction and use of the various instruments involved in mine surveying has been clearly described and illustrated. The last chapter on theodolite surveying deals with the problems connected with the use of mining theodolites and the correlation of surface and underground surveys in a concise manner. A large number of review questions and answers from former Statutory Examination Papers have been appended to each chapter enabling the student to become familiar with the types of questions set at these examinations.

Altogether the scheme of the work is so arranged that it gives a systematic drilling in the proper use of surveying instruments and methods of underground surveying that any student can easily rely on himstlf to learn the basic principles of colliery surveying without any difficulty.

The text is illustrated with simple line diagrams and explanatory numerical examples throughout, and also contains useful tables of areas, volumes and other data at the end.

P. Muruga Manickam.

The Atomisation of Liquid Fuels. By E. Giffen and A. Muraszew. (Chapman & Hall, Ltd.), 1953. Pp. ix + 246. Price 36 *sh.* net.

This book meets a real and long-felt need and gives an excellent account of the results of the work of a large number of investigators including that done by the authors. The balance is very well kept between fundamental conceptions and their application in practice, theoretical approaches and experimental technique. The chapter on the use of dimensional analysis will be appreciated by many readers.

The subject of the book is well introduced in the first chapters dealing with the mechanism of spray disintegration. The explanations and especially the numerical examples acquaint the uninitiated reader with the principles involved. Besides providing an account of fuel spray characteristics and the effect of the particulars and design of the atomiser thereon. The theoretical treatment of the swirl atomiser as example, in the next chapter, is noteworthy. The next chapters—after the interlude on Dimensional Analysis—are devoted to the study on effects of the characteristics of the liquid and of the gaseous medium in which the spray develops, on its details such as droplet size, penetration, cone angle, etc. The effects of air movements will be interesting for the diesel engine designer. After a chapter on the essential distinguishing features of intermittent and continuous sprays, the book concludes with a survey on experimental methods applied in the field, which is very welcome inasmuch as it contains hitherto widespread and scarcely available information.

Naturally, the book is essentially concerned with high pressure atomisation. However, it would be interesting to have the authors' views on low pressure, if not air, injection, and some account of possible techniques, which may have embraced even details of carburetion of light volatile fuels.

The book maintains a high standard throughout and provides information not to be found elsewhere in easily comprehensible and accessible form.

H. A. Havemann.

Nutrition in India. By V. N. Patwardhan. (*The Indian Journal of Medical Sciences*, Bombay 4), 1952. Pp. viii + 345. Price Rs. 10.

Though nutrition research has been carried out in different institutions in India during the last 40 years, only the investigations of a few people like McCarrison, McCay and Aykroyd are well known to nutrition workers throughout the world. There is, however, a good deal of information on nutrition in India, which exists either in Government reports or in Indian scientific publications which had only limited circulation in the past. The result has therefore been that quite a number of important observations of interest to nutrition workers everywhere have so far not received the recognition they deserve.

In the book under review, Dr. Patwardhan has accomplished the commendable task of

gathering most of the available material and in 23 different chapters has practically summarised the progress achieved in the field of nutrition research in India. After giving an account of the investigations carried out on common Indian foodstuffs and their peculiar methods of preparation in various parts of India, Dr. Patwardhan has devoted special attention to rice, wheat and other cereals, pulses, milk, etc., in separate chapters. Investigations carried out on vitamins and minerals have also been separately dealt with. There is a special chapter on basal metabolism followed by a detailed account of nutritional diseases in India and other diseases directly or indirectly associated with dietary habits. The concluding chapters contain an account of the nutrition work carried out in the different States and a discussion of the problem of population and food supplies in India.

This book, as rightly stressed by the author in his preface, is not meant for students but is mainly intended for research workers in India and abroad, so that they may obtain access to some valuable publications from India. In view of this, it is felt that undue prominence has been given to unpublished data in some places in the book. Also, the author could have maintained an objective approach, instead of giving expression to strong personal views on different aspects of nutritional work carried out in India. Further, in view of recent developments, tryptophane-nicotonic acid interrelationship could have been more adequately dealt with particularly in relation to the aetiology of pellagra. These criticisms apart, there is no denying the fact that the book under review, well illustrated by a number of diagrams and photographs, is a mine of information whether one seeks it from the point of view of Indian foodstuffs, or Indian dietary habits or the incidence and actology of nutritional diseases in India. The get-up of the book is very pleasing and far superior to many others published in this country.

P. S. SARMA.

Mechanism of Corticosteroid Action in Disease Processes. (*Annals of the New York Academy of Sciences*, Vol. 56, Art. 4). Edited by Roy Waldo Miner. (Published by the Academy, New York), 1953. Pp. 623-814. Price $3.50.

The title of the monograph indicates its objective, *viz.*, to throw light on the mechanism of action of steroidal hormones from suprarenal cortex, in diseased processes. The application of the hormones in diseases, widely varying in nature, from infections to metabolic disorders, has raised a veritable pharmacological conundrum. The aim of this monograph is an attempt to articulate facets in the jigsaw puzzle, to evolve, if possible, completed system of rational treatment with corticosteroids. The aim is bound to elude the grasp. But the diverse aspects studied and reported in this monograph, like the influence of adrenal cortex on vascular bed, relationship of potassium in regulation of blood pressure in corticosteroid hypertension, oxygen consumption and electrical activity in relation to adrenal cortex, influence of cortisone on granulation tissue, connective tissue, ground substance, mast cells, salicylate therapy and several others, aim at getting light to elucidate the mode of action of corticosteroids. The study reveals that a more specific effect is involved in each case than could be accounted for by a general metabolic effect. Such a trend need not detract interest from further study.

While commending this laborious study for workers in this field, one would have preferred a summary at the end of each monograph or aspect of the subject, for the benefit of those who cannot rummage through each monograph. This number of the *Annals of New York Academy of Sciences* should find a place in any library catering to the study of biochemistry, pharmacology and medicine.

V. ISWARIAH.

Phylogeny and Morphogenesis (*Contemporary Aspects of Botanical Science*). By C. W. Wardlaw (Macmillan & Co., London), 1952. Pp. viii + 536. Price 42 *sh.* net.

Despite the extreme narrowness of specialisation in every field of science, there is to-day an urgent need for integrating the many branches of science in understanding even the chosen fields of specialisation of the individual scientist. Never before has there been so much written on teamwork among scientific workers than at the present time and judging from that point of view, Prof. Wardlaw's new book is of exemplary nature in that it summarises admirably the experimental aspects of genes and development, genetic constitution in relation to shape, size and differentiation, biochemistry of morphogenesis and histogenesis and lastly mathematical considerations in the study of these subjects together with an excellent chapter on experimental morphology.

The earliest chapters of the book deal largely with phyletic methods as exemplified by the Pteridophytes drawing freely from examples of extinct and living genera. These phylogenetic

studies of contemporary workers have been ably epitomized and rightly great prominence is given to the new orientation afforded by the pioneering work of Prof. Manton on the cytology of Pteridophytes. It is noteworthy that the classical work of Bower on the Ferns, which was undertaken at a time when this new experimental and cytogenetical facet of Pteridophyte study was not initiated, would have immensely benefitted by the many speculative writings on the evolutionary activity in that group if it were only possible to look in retrospect. This new field of Prof. Manton is worthy of commendation to Indian workers as the chromosome numbers of many a wild species of fern occurring amidst our numerous high altitude floras have remained for long a mute story. The composite nature of *Dryopteris* and *Thelypteris* showing widely differing ancestry and owing their resemblance to parallel evolution and the even more startling discovery that the ferns are a very varied assemblage and that the primitive *Ophioglossum* shows in one species *O. vulgatum* the highest chromosome number yet discovered in a wild species in the plant kingdom are subjects of immediate concern to Cytogeneticists.

Much can be written in praise of the many interesting chapters of this book which sound like the saga of living plants and its many faceted life processes. Biochemical morphogenesis and histogenesis are two chapters that need careful reading and assimilation. Experimental approach to many branches of botanical science has been stressed in recent years and the discovery of hormones and their influence on tissue culture and *in vivo* experimentation has opened up new avenues of fruitful investigations and these and related subjects are well presented. The book terminates with a chapter on 'Towards a synthesis', where much of the literature presented in preceding pages are summarised. Undoubtedly this book embodies much material indicative of a new approach to the fast advancing botanical science and has more than suggested many broad lines of investigation aiming at a convergence of the twin branches phylogeny and morphogenesis. I commend this well-written and excellently printed book for careful assimilation of the many new approaches made in recent years in a branch of science where orthodox approaches to plant taxonomy and phylogenetic classification have received a new orientation in the hands of the 'experimental botanist'.

T. S. SADASIVAN.

Name This Insect. By Erich Fitch Daglish. (J. M. Dent & Sons), 1952. Pp. xxvi + 294. Price 15 *sh.* net.

A handy, handsome volume of octavo size, bound in bright green cloth with the figure of a slender water-gnat in gold as the central motif on the front cover, rendered still more attractive by a cover flap bearing illustration in colour of various common insects, this publication may very well serve as a presentation book to friends with a bias for natural history.

The publication is intended to serve the needs of laymen in the British Isles who are interested in natural history, but have neither the time nor the patience to refer to learned volumes of insect classification to identify various common insects they may meet with in the course of a walk. The author has given simple keys for working out the names of insects, based on easily recognizable characters such as the peculiarities of shape and coloration of the head and snout, the feelers, the legs, the wings and other parts of the body. The keys are easy enough to enable the reader to find out the common name of the insect captured, and in many cases, also to get information on its life-history and habits. The reader may derive immense help in this task by a reference to the plentiful illustrations of common insects contained in the book, there being 16 colour plates containing figures of 85 different species, as well as 48 plates of black-and-white half-tone illustrations of 265 other species. There is little doubt that the book will be found useful and popular in the United Kingdom.

Outside the British Isles, however, it may not serve the same purpose, as in many cases the species of insects met with may be totally different, but all the same, the reader may be enabled to recognize the class of insects, to which they are allied.

One would rather wish that there were available in India, a book of this character, dealing with the common species of Indian insects, to enable the non-technical layman, as well as students interested in natural history, to recognize the common insects.

Considering the large number of excellent illustrations, especially the coloured ones, the advertised price of the book is modest enough.

Y. R. RAO.

Books Received

Annual Review of Biochemistry, Vol. 22. Edited by J. Murray Luck. (Annual Reviews Inc.). Pp. ix + 729. Price $ 6.00.

A Spectrophotometric Atlas of the Transition of OH. (NBS Circular 541). Pp. 21. Price 20 cents.

Animal Biochromes and Structural Colours. By Denis L. Fox. (Cambridge University Press), 1953. Pp. xiii + 378. Price 60 sh. net.

Mathematical Aspects of the Quantum Theory of Fields. By K. O. Friedrichs. (Interscience Publishers). Pp. viii + 272. Price $ 5.00.

Geology of India, 3rd Edition. By D. N. Wadia. (McMillan & Co.), 1953. Pp. xx + 531. Price 50 *sh.* net.

Introduction to Dynamics. By L. A. Pars (Cambridge University Press), 1953. Pp. xxii + 501. Price 31 *sh.* 6 *d.* net.

Manual of Indian Forest Botany. By N. L. Bor. (Oxford University Press), 1953. Pp. xv + 441. Price Rs. 25.

Biochemical Transformations of Starch and Cellulose. Edited by R. T. Williams. (Biochemical Society Symposia No. 11, Cambridge University Press), 1953. Pp. 84. Price 10 *sh.* 6 *d.* net.

Organic Analysis, Vol. I. By J. Mitchell, I. M. Kolthoff, E. S. Proskauer, A. Weissberger. (Interscience Publishers Inc.), Pp. viii + 473. Price $ 8.50.

Tables of Dielectric Constants and Electric Dipole Moments of Substances in the Gaseous State. (United States Dept. of Commerce). NBC Circular 537, 1953. Pp. 29. Price 20 cents.

Elements of Forest Economics. By Sven Petrini. Translated by Mark L. Anderson. (Macmillan & Co.), 1953. Pp. viii + 210. Price 22 *sh.* 6 *d.* net.

Selected Values of Physical and Thermodynamic Properties of Hydrocarbons and Related Compounds. (Carnegie Institute of Technology), 1953. Pp. ix + 1,050. Price $ 7.00.

The Birds of Burma. By Bertram E. Smythies. (Revised Edition). (Macmillan & Co.), 1953. Pp. xiii + 668. Price £ 4 4 *sh.*

Practical Chromatography. By R. C. Brimley and F. C. Barrett. (Chapman & Hall), 1953. Pp. 128. Price 15 *sh.*

SCIENCE NOTES AND NEWS

The Delhi Pillar

The freedom from rusting of the famous iron pillar at Delhi has long been a subject of comment and has been attributed by many writers to the peculiar properties of the ancient iron from which it is forged. Although some particulars of its history are obscure, it seems certain that the pillar dates from about the fifth cetnury A.D. and is roughly 1,500 years old. The immunity of iron from rusting over such a long period is a striking phenomenon. In this connection the results of some experiments reported by J. C. Hudson in *Nature* (1953, 172, 499) are of great interest.

Small specimens, 4" × 2", of steel (⅛" thick) and zinc (1/20" thick) were exposed in the open air near the pillar for 1 year and their losses in weight were then determined after the corrosion products had been removed. The corrosion-rates were compared with the results of similar tests made at other stations, both in England and overseas.

These make it clear that the corrosive conditions at Delhi are very mild. It is known from the classical researches of W. H. J. Vernon that the relative humidity of the air is the primary controlling factor for the atmospheric corrosion of iron and that little or no rusting occurs unless the humidity exceeds 70 per cent. The meteorological data for Delhi show that this critical value would only be reached for a short time during the whole year. Presumably, too, the sulphur pollution of the atmosphere, which, as Vernon demonstrated, controls the corrosion rate when the humidity reaches the critical value for rusting, is but slight in the neighbourhood of the iron pillar.

Indeed, the zinc specimens were so little corroded that they retained much of their original polish after a year's exposure there. In Hudson's view, therefore, the lack of serious rusting of the pillar is to be attributed to the mildness of the local climate rather than to any intrinsic superiority in the corrosion resistance of the iron itself.

Flying Saucers

In an article in *Science* (1953, 118, 124), C. C. Wylie of the State University of Iowa describes his investigations on 'flying saucers' which have been much observed in the United States. Wylie concludes that these are simply reflected sunlight having the following characteristics: (1) they are seen only when the sun is shining; (2) they are generally seen in the part of the sky opposite the sun; (3) there is only one sighting on each saucer, as the area for the critical angle is small.

Synthesis of Pituitary Hormone

The synthesis of oxytocin, a hormone from the important pituitary gland, has been announced by Dr. Vincent Du Vigneaud, Professor of Bio-Chemistry at the New York Hospital, Cornell Medical Centre, in a recent issue of the *Journal of the American Chemical Society*. Oxytocin is the first protein hormone to be synthesised and the first to have its exact chemical make-up determined.

International Union of Crystallography, 1954

The Third General Assembly and International Congress of the International Union of Crystallography will be held in Paris during July 21-28, 1954. At the Congress, papers will be presented on all aspects of crystallographic research; there will also be an exhibition of crystallographic apparatus and books. After the Congress two specialized symposia will be held on "The Location and Function of Hydrogen" and "The Mechanism of Phase Transitions in Crystals", and there will be visits to localities of mineralogical interest. Full details of the meeting may be obtained from the General Secretary of the Union (R. C. Evans, Crystallographic Laboratory, Cavendish Laboratory, Cambridge, England), or from the Secretary of the Programme Committee (A. J. Rose, Laboratoire de Mineralogie, 1 rue Victor Cousin, Paris 5, France). Offers of papers for the Congress and symposia and notice of enrolment must reach the Secretary of the Programme Committee (preferably on the form accompanying the first circular) by February 15, 1954. All general correspondence should also be addressed to the Secretary of the Programme Committee.

The Palaeobotanist

Volume 2 of the Journal has now been published (price Rs. 20). Volume I (Birbal Sahni Memorial Volume) is also available (price Rs. 50). The prices are inclusive of postage. Copies of the two volumes can be obtained on application from the Registrar, Birbal Sahni Institute of Palæobotany, 53, University Road, Lucknow (India).

Dr. S. Husain Zaheer

Dr. S. Hussain Zaheer, Director, Central Laboratories for Scientific and Industrial Research, Professor and Head of the Department of Chemical Technology, Osmania University, Hyderabad-Dn., has been nominated by the Institution of Chemists (India) to deliver the H. K. Sen Memorial Lecture for the current year.

Progress Review in General Zoology

Material relating to *General Zoology* is invited from research workers for inclusion in the yearly review publication of the NIS entitled "Progress of Science in India" for the years 1951-53. They may be forwarded to Dr. B. S. Chauhan, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta 12, as and when published.

Essay Contest

The Indian Dairy Science Association has organised an essay contest open to all *bona fide* students of dairy, agricultural, veterinary and other educational institutions and research institutes. The subject of the essay is "Application of Refrigeration in Improving the Dairy Trade in India". The essay should be written in English, not exceeding 3,000 words, and three typed copies must be sent to the Association before 15th January 1954. Further particulars can be obtained from the Hon. Secretaries, Indian Dairy Science Association, Hosur Road, Bangalore-1.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Chemistry to Mr. G. Viswanath for his thesis entitled "Absorption Spectra of Certain Bicyclic Compounds and Disubstituted Benzines" and the D.Sc. Degree in Pharmocology to Mr. V. Subba Rao for his thesis entitled "A Study of Some Indian Medicinal Plants".

The University of Bombay has awarded the Ph.D. Degree in Chemistry to Sri. N. H. Sivarama Krishnan for his thesis on "The Spreading Properties of Rubber and Rubber Derivatives".

The University of Poona has awarded the Ph.D. Degree in Biochemistry to Shri Madhav Vinayak Patwardhan for his thesis entitled "Experimental Liver Injuries".

Addendum

Vol. 22, No. 10, p. 293: Article on "The Importance of Mid- and Upper Tropospheric Thermal Systems.....during the Nor'wester Season": The following is to be added as a footnote at the end of Column 2:

N.B.—In Figures 1 to 4, the wind arrows with shafts as continuous lines denote thermal winds between 10,000 and 18,000 feet, while the arrows with shafts as broken lines denote thermal winds between 10,000 and 20,000 feet. Winds at 20,000 feet were used when 18,000 feet winds were not available.

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